The FOUNDRY

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Castings Open the Channel for Lake Shipping

SHIFTING sand on the lake bottom is a source of expense to harbor authorities and the cause of anxiety to Great Lake ship captains. At all times throughout the shipping season, dredges of various types are at

Dredges Keep Harbors and Channels Open for Shipping on the Great Lakes

work keeping the harbors and rivers navigable. While not an exceedingly difficult job, transporting boat loads of sand from the bottom of the harbor or river to the outside of the breakwater requires special equipment. The accompanying illustration shows the MOGUL, owned and operated by the Great Lakes Dredge & Dock Co., Chicago, one type of dredge used for that purpose. This unit is of the diesel engine type with electrically driven operating machinery. Another type dredge used for that purpose is the so-called sand sucker, which sucks the sand into its hold through long pipes that travel along the bottom. The most recent and probably the largest and most modern of that type is the new J. R. SENSIBAR, commissioned in 1930. Both types of dredges utilize castings to secure maximum service. On the dredge shown in the illustration, the engine, electrical machinery, bearings, pulleys, gears, sheaves, etc. all are castings. In the sand sucker type, many abrasive and impact resisting castings are used. Castings are doing their part to keep commerce moving on the Great Lakes.

Find Where Castings Can Be Sold

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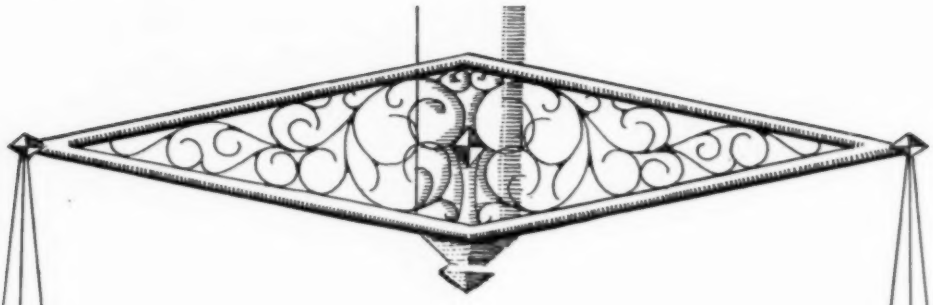


STRIKING A BALANCE

Between *Lower*
Raw Material *Prices*

And *Higher*
Operating *Costs*

The Questions

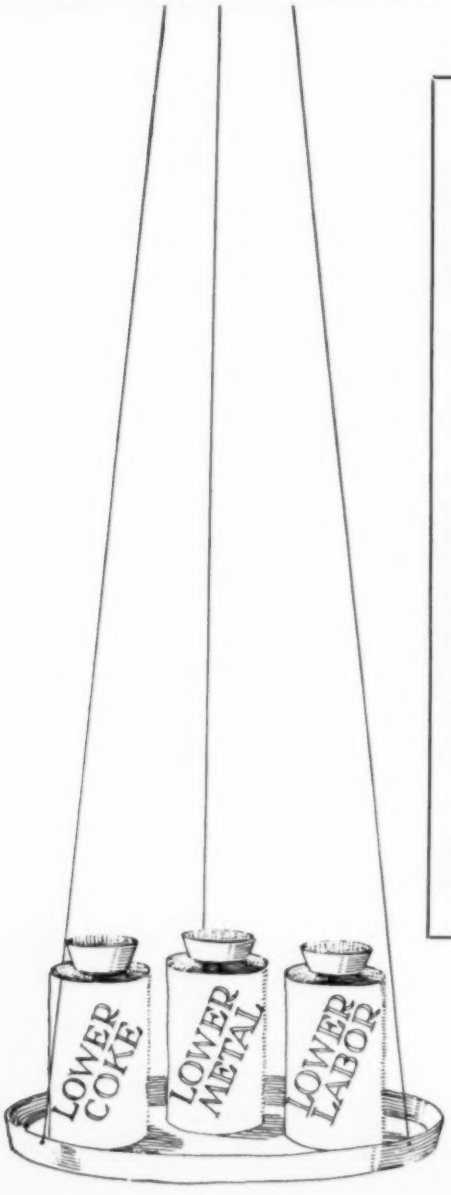
HOW does the price of pig iron per ton affect the price of castings per pound, for instance, how will $1.00 per ton change in pig iron cost affect the cost of castings in cents per pound?

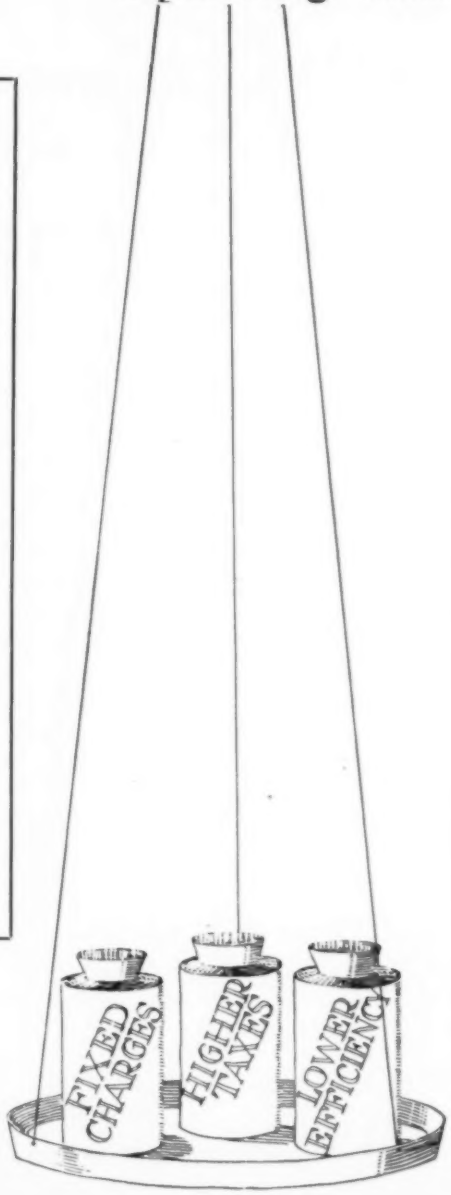
How much will $1.00 per ton change in coke affect castings costs in cents per pound?

How much does $1.00 per day change in molders' wages affect the cost of castings in cents per pound?

How many pounds per day will an average molder be able to put up, say in the three different groups of light, medium and heavy castings? By light castings we mean those weighing under, say five pounds. By medium those from say, five pounds to 50 or 100 pounds and heavy castings on up to say, 2500 pounds. Of course, the type of the casting and probably the core work will have something to do with the amount but we merely want average conditions, and would like to have the data if you could give it to us.

How many pounds of good castings are obtained from one ton of melted iron? This, of course, would take into consideration the sprue, gate risers, etc., as well as normal scrap.





Part Time Operation Increases Expense

IN EVERY era of declining values, buyers can bring comparative figures to bear upon the basic structure of prices. These comparative figures need not come directly from items which enter into the cost of the product they buy. The automobile buyer may quote the decline in ferromanganese as authority for demanding a discount, or at least a larger trade-in allowance on the old conveyance.

Of course, if a buyer is acquiring a semifinished product upon which the basic price of raw materials is a primary factor, greater weight may be attached to his insistence. Obviously, the foundryman expects to pay less for his pig iron when ore and coke alike decline.

The wide difference between a semifinished and a finished product is not always easy to explain. This is particularly true when either party to a purchase or sale seeks information upon the divergent relations between semifinished and finished products.

Foundryman Analyzes Cost Factors

Castings for many years have escaped general classifications into either the finished or semifinished divisions. The foundryman and the customer who buy and sell upon a price-per-pound basis probably regard castings as a semifinished product or perhaps even lower on the scale, a mere commodity like sand or beans. The foundry which sells castings by the piece and the purchaser who expects a casting to be a definite machine part, designed and constructed according to engineering principles, probably would classify castings as a finished product.

Under the present business conditions probably the purchaser, whether he buys his castings as a finished or semifinished product, is scanning every item which will give him a better price.

Casting buyers are evidencing a polite but insistent interest in factors of foundry cost. The few shops which have survived the storm unassisted by any logical method of determining their manufacturing costs are becoming more receptive to the idea of scientific determination of basic costs. Jobbing foundries that have jogged along placing their dependence upon cost methods which were good and sufficient in days of prosperity, now are beginning to wonder. Even those enlightened foundrymen who through business sagacity or under pressure of competitive conditions have looked beneath the surface to analyze every factor of their castings cost, are inquiring into the adequacy of their data. These facts are symptoms of the times.

Those foundries that operate cost systems which give detailed information are in position to enlighten purchasers as to the effect of lower raw material prices upon the cost of castings. Under the old dark age methods of average or weight classification prices, this would not have been so readily achieved. Even the most advanced foundries under present circumstances find it necessary to reduce prices to meet competition, but at any rate they have the satisfaction of knowing how much they are losing. Bidding on a competitor's price never is sound practice, but if a foundryman knows that a competitor's price is entirely too low, he has the satisfaction of knowing how much too low it will be necessary to go to hold the business.

Buyer Is Not Censored

The buyer of castings is by no means to be censored. He has a right to buy his castings at the lowest prices obtainable consistent with the quality that he must have. Accordingly, the purchaser who requests a reduction based upon a recession in raw material prices has a right to know how much of a discount in castings prices may be expected. The foundryman should welcome consultation with customers that are sufficiently fair-minded to study this subject.

Recently an inquiry directed to the editorial office of THE FOUNDRY raised just these questions. The inquirer, actuated by a sincere desire to know more about foundry costs, addressed to THE FOUNDRY the questions which are shown on the opposite page. The author of these questions operates a large machinery manufacturing plant which uses quite a sizable tonnage of gray iron castings. It was explained in answering the first letter containing these questions that the influence of the items mentioned upon the price of finished castings might be inconsequential.

Obviously, the effect of the price of pig iron would vary with every change in the proportion of pig iron and scrap; the melting ratio would affect the saving due to a drop in the the price of coke; molders' wages would vary more in relation to the output, etc.

However, in deference to the frankness of these questions which were submitted in a sincere desire on the part of the buyer to be fair with his castings source, these questions were submitted to a number of outstanding men noted for their knowledge of sound cost methods and their sincerity in following them. The questions were taken to be typical of many which are being encountered by hundreds of foundrymen throughout the country whether

they are engaged in gray iron, steel, malleable or nonferrous practice.

One of the first thoughts that suggested itself in this discussion was the evident fallacy of continuing to sell castings upon a price-per-pound rather than a price-per-piece basis. In other words, regarding castings as a bulk commodity rather than a finished engineering structure gives rise to just such misunderstanding as is evidenced by the inquiry of this castings buyer.

Criticizes Cost per Pound

One of the first responses received from a prominent gray iron foundryman emphasized this fact. He says:

The more I see of this type of inquiry, the less I think of the idea of selling castings by the pound. Of course it is a convenient way to figure your cost on a group of castings and then divide by the tonnage and arrive at a pound price. Frankly, it would be just as easy to figure an automobile costing $1000 and weighing 1000 pounds at $1.00 per pound, and sell it that way. If this were done, this same buyer would inquire how much it would add to the cost of that automobile if the price of steel went up $1.00 per ton. Castings are a simple enough commodity, but not nearly as simple as some buyers think.

A new spirit is evident in the foundry industry based upon the broader knowledge of sound cost accounting. One of the foremost exponents of better cost methods and adherence to cost principles operates a gray iron shop which makes medium and heavy castings and in recent years has specialized on high quality castings. This man says:

If we were to receive a letter of this kind from a customer, we would go and see him in an attempt to show him that the cost of manufacturing castings involved so many factors that the effect of one item becomes involved and usually is of small consequence.

In this case where we have to discuss these things by letter, we would say that inasmuch as gray iron castings are a cheap commodity, it takes generally fairly large variations in price of any one item of coke, pig iron, or wage-rate, etc., to influence the cost price by more than a small fraction of a cent per pound. This fraction of a cent per pound usually is less than the general gradations used in pricing castings. Therefore, for pricing, it is not expedient to attempt to regulate the price of castings directly with all market variations in prices of individual commodities. But casting prices should vary only as general raw materials used and labor prices vary sufficiently to create a reasonable fraction of a cent ultimate difference of manufacturing cost.

In fact, one reason for the unhappy relation between cost price and selling price, today, has been an overestimate of the effect of costs by individual items so that when pig iron dropped sufficiently to affect the price—say 1/20c per pound, the poor foundryman is talked into granting a ¼c cost reduction of price.

It is significant that the tone of this buyer's inquiry elicits a different reaction from foundrymen today than it would have 6 or 8 years ago. At that time such a curiosity with regard to factors in castings cost would have been put down purely as impertinent curiosity or perhaps a predatory interest in destroying the price structure. Today foundrymen believe that buyers are less inclined to extract the last pound of flesh and they doubt the belief that all purchasing agents wear horns. Reference to this changed attitude is found in the comment of the president of a prominent gray iron jobbing foundry who says:

After reading this letter carefully, I am wondering if it might not be easy to misjudge the motive of your correspondent, for it seems to me that he is actuated by a legitimate desire for knowledge of foundry costs, and that there is a possibility of his wanting this information to give him a clearer picture of actual foundry conditions. If it was my belief that exactly this

same inquiry coming from a customer was the result of a desire to obtain accurate information. I would be only too glad to answer each of the questions to the best of my ability.

Of course there is a possibility that his only motive in a request of this kind, is to use such information as he gets to beat down the price on castings, but I believe that we are all too prone to look at the short-comings of the comparatively few purchasing agents who use unfair methods and forget the greater number who really listen to reason.

There are numerous buyers who insist upon having their suppliers meet unreasonable prices that have been quoted them, but it does not seem to me that the fault here lies as much with the buyer of castings as it does with the foundryman who has quoted the unreasonable prices.

Good Prices Secured

A fact which is brought prominently to the fore by the discussion is the influence of the decreased rate of operation upon costs. Whether this factor, coupled with the increase of overhead and the loss of efficiency due to intermittent operation will more than outweigh the saving due to lower raw material prices, is worth consideration. In this regard the same foundryman previously quoted says:

We have always endeavored to operate our plant as nearly as possible as a department of our customers' business, feeling that in good times we are entitled to only a reasonable profit, and by convincing our customers of this fact, in many cases it has been easier for us to obtain reasonable prices when business is poor.

Of course, in times such as these, because of the small volume of business, costs increase to a point where profit cannot be thought of. Therefore, prices must be made on the basis of *normal* overheads, which reflect a condition that would prevail if approximately 75 per cent of the plant was operating.

It is my opinion that if the foundryman will take the average customer into his confidence, give him a reasonable explanation for any points such as these that he may bring up that are not exactly clear to him, and then quote reasonable prices only, most of the business ills will clear themselves quickly.

The point emphasized by this found-

ryman apparently is indicative of the attitude of the modern and alert jobbing castings manufacturer. It represents the new concept of business transacted upon a basis of mutual respect and confidence. Apparently, even sharp-shooting buyers are awakening to the fact that constantly changing sources is poor business. A case recently cited of an automotive interest with a new executive personnel, that overthrew a foundry connection of many years standing to shop around for lower prices is, happily for all concerned, an exception.

Of course no repeal nor evasion of fundamental economic laws is possible. But the experienced casting buyer knows that to disrupt an old connection, pull his patterns out of the sand in a shop where he has secured satisfactory castings for years and then expect some new and untried source to meet his requirements immediately is expecting much. Even the new contacts with different personalities, requires living over old experiences which in the main are not salubrious.

Customers of Two Types

This feature is strongly emphasized by the head of a large malleable foundry who says:

Our contacts are entirely with consumers of malleable castings, and we find that they are of two classes. The first is represented by our regular customers of long standing but varied experience in purchasing, who have found that the temporary ups and downs of markets do not warrant them in making very frequent and drastic changes in sources of supply. Such buyers have learned that a conservative source makes no effort to exact a premium in times of large demand and therefore expects to be treated with like consideration in such markets as the present.

The other class of buyers is more easily prevailed upon to change sources because of a lower price and pressure for lower costs in his own operations. His experience apparently has not been diverse enough for him to know that the change of patterns, methods of manufacture, lack of acquaintance with the work and personnel at both ends, frequently make a change of source very expensive for the buyer and damaging to both the old and the new seller.

It is in such times as the present that every source needs all of its present customers and is willing to go right down to costs or below in order to hold those customers. If they cannot be held during lean periods when the business is really needed, their value to a source depends entirely upon getting a fat profit at times when other buyers are abundant. New sources have frequently made mistakes in calculating costs due to unfamiliarity with requirements, equipment furnished, and manufacturing practices of the buyers, so that they too, lose by taking on new customers at the low price levels which prevail in such markets as the present.

The discussion, thus far, has considered the general features of the relation between buyer and seller of castings. The facts elicited are fundamental. A proper concept of their importance is one long step in better merchandising of castings.

However, none of these features serves to answer the specific questions raised by the buyer. He would not be satisfied with the generalities quoted and advanced, but would feel and perhaps rightly, that his specific questions should be answered in considerable detail.

Fundamental teachings of the world's best merchandising minds agree upon the vital necessity for answering a customers definite questions. Such answers should be honest and based upon sound facts, but not argumentative in character.

Concurs in Opinion

THE FOUNDRY concurs in this opinion, especially since a further letter from the manufacturer quoted specifically disclaims any intent to beat down casting prices, or to use the threat of changing his account to another source, using the information as a lever to achieve this purpose. This further letter states:

We can advise you that we are not prompted to ask this question with the idea of obtaining a lower price from our foundry as we have already been in touch with our foundry and have obtained what seems to be a reasonable figure for conditions as they are today. What we are after however, is to have some of these basic figures so that at any time basic prices change, we will be able to figure out how such changes should effect the price of castings and in that way we would have a better understanding with our foundry and no doubt, deal more fairly with them. The fact that we have dealt with one foundry for over 30 years is probably pretty good proof that we deal fairly and do not take any unfair advantages.

We feel, however, that if we can have certain information that would allow us to check up on prices we would be in a better position to grant an increase, if an increase was reasonable, and was asked for; or we would be able to refrain from asking for a decrease if we understood thoroughly that a decrease was unreasonable.

We have discussed costs with our foundry but in all instances, whether it be foundry costs or what other costs, we always like to check figures from basic sources as we then feel better satisfied that no special or unusual conditions enter into the cost figures of the people with whom we deal.

Therefore, the replies to the definite questions as answered by a number of those to whom the blind inquiry was directed will be of distinct value. These, including the views of gray iron, steel and malleable foundry operators followed by a complete tabulation submitted by one steel foundryman will follow in early issues of THE FOUNDRY.

Milwaukee Apprentices Attend Dinner

Approximately 475 apprentices and officials of machinery building plants attended the annual dinner given by the Milwaukee branch of the National Metal Trades association at the Milwaukee Vocational school, Feb. 16. The dinner is given for those apprentices who are in the last year of their course and for those who have won awards during the past year in apprenticeship competition. The principal speaker of the evening was Col. Roy Farrand, president, St. John's Military academy, Delafield, Wis. Harold S. Falk, vice president and works manager, Falk Corp., Milwaukee, and chairman of the National Metal Trades asociation apprenticeship committee, acted as chairman of the meeting.

Winners of the various prizes in apprenticeship contests are as follows: PATTERNMAKING, first prize, Dege Raash, Heuer Pattern Works; second prize Albert Kitzrow, Harnischfeger Corp.; third prize, Boleslaus Kafczynski, George H. Smith Steel Casting Co.; IRON MOLDING, first prize, Daniel Lyles, Harnischfeger Corp.; second prize, Joseph Biersack, Harnischfeger Corp.; third prize, Frank Muren, Allis-Chalmers Mfg. Co.; STEEL MOLDING, first prize, Steven Bakic Sivyer Steel Casting Co; second prize, Albin Halquist, Falk Corp.; third prize, Stanley Siwakowski, Sivyer Steel Casting Co.; DRAFTING, first prize, Ray Mueller, Allis-Chalmers Mfg. Co.; second prize, Robert Schweninger, Allis-Chalmers Mfg. Co.; third prize, Anton Yank and Lester Piel, Allis-Chalmers Mfg. Co., tied.

The committee that arranged the dinner consisted of John Roth, Nordberg Mfg. Co., chairman; E. S. Liston, Allis-Chalmers Mfg. Co.; George Havlista, Kearney & Trecker Mfg. Co.; and Frank Rahkonen, Kempsmith Mfg. Co.

Officers Are Elected

The following officers were elected at the recent meeting of the board of directors, Harnischfeger Corp., Milwaukee: Walter Harnischfeger, president and treasurer; E. Standfuss, vice president; R. Binkowski, secretary; C. Haugaard, assistant treasurer; and F. J. Hartmann, assistant secretary. The new board of directors consists of Walter Harnischfeger, R. Binkowski, E. Standfuss, Walter Kasten, Louis Quarles, J. Harnischfeger, R. von Schleinitz, all of Milwaukee, I. L. Porter, Chicago, and J. O. Eaton, Cleveland.

Glove Steel Abrasive Co., Mansfield, O., recently placed in operation a new addition to its plant which has doubled the capacity. The installation includes modern equipment designed by the Globe Steel Co.

Prevent Losses With Proper Gates and Risers

By Pat Dwyer

PROPERLY speaking and in keeping with the proposed recommendation of the American Foundrymen's association committee on foundry nomenclature, the term *runner* should be applied only to the central member of the three parts making up the passage for the entrance of metal to the mold. The three parts are known as the sprue, the runner and the gate. However, custom has sanctioned the use of the term as a synonym for pouring basin and in many places it is the only term employed to designate the basin, cup or head which receives the iron directly from the lip of the ladle.

Difficulties Are Encountered

This is one of the many peculiar features which confront any individual, committee or association in its efforts to introduce directness and simplicity into an admittedly difficult situation. Under present conditions the basin, long or short, round, oval, rectangular or square which conducts the molten iron to the vertical sprue, is known as the runner. After the casting is poured, the metal remaining in the basin, also is known as the runner. Perfectly logical and reasonable to the man in the foundry, but distinctly puzzling to any other person. This mythical outside person cannot reconcile his mind to accepting one word describing a hollow or passage in the sand, and the same word applied to the solid mass of iron in it.

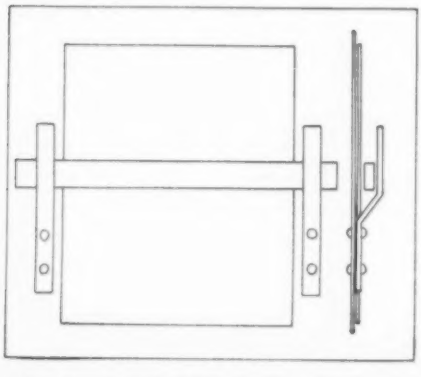


Fig. 26—The Plate Across the Opening Is Held in Place with a Bar

Use a Reservoir

WHERE the crane or ladle capacity is inadequate, the foundryman is forced to improvise some form of reservoir to hold the required amount of metal. The casting usually is an emergency job of some kind and in all probability never will be duplicated. For that reason any device adopted must be held to a minimum expenditure of time, material and money. A fairly wide choice is available and the experienced foundrymen will encounter little difficulty in selecting a type of reservoir to meet his particular requirements. Another type of reservoir is designed to hold just the correct amount of metal to fill the mold. The sprue is plugged until the reservoir is filled, then the plug is removed and the metal flows by gravity into the mold. One of the advantages of this method is that any impurities present in the metal, also any charcoal employed to conserve the heat, remain on the surface and cannot enter the sprue with the flowing iron.

If the tern pouring basin is accepted, this difficulty will extend into the foundry. The term pouring basin is an accurate description of that device, but the term is not exactly applicable to the iron which remains and solidifies in the basin. Apparently a new word will have to be coined and circulated through the foundry field before this problem will be solved. Suggestions now aro in odrer.

Unfortunately in the foundry as elsewhere old customs die hard. A considerable degree of truth attaches to the well known saying "You can't teach an old dog new tricks." The present generation of foundrymen probably will stick to the easy informality which permits reference indiscriminately to any part of the ensemble, either passage or metal, as a gate or a runner. The entire subject was dismissed recently by one of these incorrigibles with: "Why bring that up? A rose by any other name smells just as sweet!"

In some instances a reservoir serves as a pouring basin, but in the majority of instances the term reservoir is applied to a device in which a supply of molten metal is accumulated preparatory to pouring a large casting. Usually a reservoir may be classified under the heading of emergency equipment since it is brought into play only where the ladle or crane capacity of the shop is not equal to handling the amount of metal involved.

Reservoirs Test Ingenuity

Many foundrymen favor the use of a reservoir ladle under the cupola spout to insure a more thorough mixture of the metal and to facilitate the distribution of the metal in small ladles. In this manner the entire amount of metal in the well of the cupola at any given time may be taken out at one tap, instead of in many taps as would be required if each ladle was filled individually. Where the metal runs in a constant stream from the cupola, a reservoir ladle serves as an elastic link in the chain of small ladles which pass in front of it. The reservoir ladle takes up the slack where, for any reason, the intervals between the small ladles are not spaced evenly.

Further reference to this type of re-

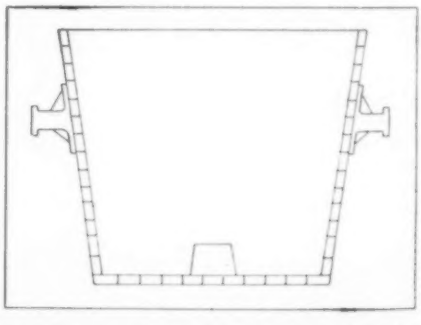


Fig. 27—A Stationary Ladle May Be Tapped Through Side Near Bottom

servoir lies outside the scope of the present series of articles devoted to the subject of gating in its almost endless ramifications. Reservoirs which properly may be included are those which form part of the equipment built up around a mold for the purpose of delivering molten metal to the sprue.

Ingenuity of the foundryman often is taxed severely in the designing and construction of a reservoir that will serve his purpose. In extreme instances he may be forced to fashion the reservoir from sand with the banks reinforced with pig iron as shown at *A* in the illustration Fig. 29. Usually this type of reservoir is built with one side under the cupola spout so that the hot metal from the cupola may be tapped into it directly, to conserve the heat. The bottom of the reservoir is heated in advance by a wood coke, coal, gas or oil fire, depending on the most convenient and available fuel. Wood, probably is best since the charcoal and ashes form a protective coating for the molten metal after it commences to accumulate. A thick coating of charcoal is maintained on the surface of the metal so long as it remains in the reservoir.

This precaution of covering the metal to retain the heat is even more important where the reservoir is built at some distance from the cupola and the metal has to be transported to it in ladles. Naturally the temperature of the metal is reduced to a considerable extent in the transfer process.

Other Methods Described

Instead of a sand bank, the foundryman may be in a position to utilize a boiler plate ring, or any one of the several types of curbing rings employed in foundries where loam molding is practiced. A tap hole is made up practically in the same manner as in a cupola. In some instances as an extra precaution against possible accident, it may be advisable to latch a small door in place at the outer end of the tap hole as shown in Fig. 26. When the time comes to tap the metal in the reservoir, the plate is removed first and then the sand in the tap hole is worked out with a sharp bar.

Where three ladles are required to pour a large casting and only two cranes are available, a third ladle may be fitted with an opening near the bottom as shown in Fig. 27. This ladle is set up in a suitable manner near the end of one pouring basin. The opening near the bottom is plugged as outlined previously until the required amount of metal has been accumulated. Then it is opened at the same time the ladles suspended from the cranes are tipped to discharge their contents. The ladle, in common with other forms of reservoirs, should be heated thoroughly before any iron is poured into it. Otherwise the metal will solidify in the bottom before the time arrives for the pouring of the casting.

Another type of reservoir was illustrated in Fig. 16. presented in the Jan. 15, 1931 issue. This reservoir is designed to hold sufficient metal to pour the casting. The opening in the bottom of the reservoir, otherwise the top of the sprue, is closed with an iron plug coated with blackwash and dried. The plug is provided with a vertical rod terminating in a loop or

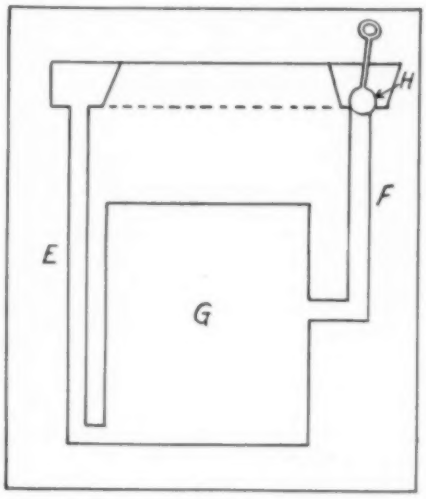


Fig. 28—Metal Enters the Mold at Two Levels from a Common Runner Basin Fitted with a Plug

an eye for a handle. In some instances a man standing near the basin lifts the plug at the proper time, by inserting the end of a long bar in the eye.

In other installations, particularly where several plugs are employed to seal several openings, another method is used. A light wire cable is hooked to each eye. The cable then is reeved over a small block suspended from one of the roof members or from any other convenient support. The free end is grasped by an attendant standing on the floor. When the basin or reservoir is filled with metal, a signal is given and the plugs are pulled simultaneously. This method is practiced extenisvely in statuary and art foundries.

An adaptation of this method sometimes is employed in pouring a large casting with a single ladle where conditions suggest the advisability of introducing metal into the mold at more than one level. This is illustrated in Fig. 28 where metal from a common basin runs down the sprues *E* and *F*. The sprue *E* discharges the molten iron through a gate at the bottom of the mold *G*. The sprue *F* introduces the metal at a point about half way between the top and the bottom.

In an instance of this kind the iron plug *H* is placed in the bottom of the pouring basin immediately over the top of the sprue *F* and is left there until the metal entering at *E* has risen approximately to the level of the gate at the bottom of the sprue *F*. The man manipulating the ladle, or some other competent person decides this point.

Progress Is Watched

Occasionally any person may look down a riser and note the progress upward of the metal, but in the majority of cases this is not possible. In many instances the interior construction of the mold, or the position of cores, interferes with the line of vision. In others the height and volume of the jet of hot air emitted by the riser effectually prevents the application of the human eye.

The ability to accurately estimate the amount of metal in the mold, or more properly speaking, accurately visualize the height of metal in the mold at any given time, only can be acquired by actual experience and observation.

Actual rules of course are available for estimating the total amount of metal required to fill any mold. These rules are based on the volume of the pattern employed in making the mold and on the weight of a cubic inch of iron, 0.26, or approximately one quarter of a pound. The amount of metal a ladle will hold, while filled to any given level can be estimated by the same rules.

During the actual process of emptying a ladle, no time is available for working out any extended calculation. The man in charge of the job is aware through a species of instinct of the relative status of the iron in the ladle and in the mold, and therefore is in a position to order the removal of the stopper from the second sprue when the iron has risen a sufficient

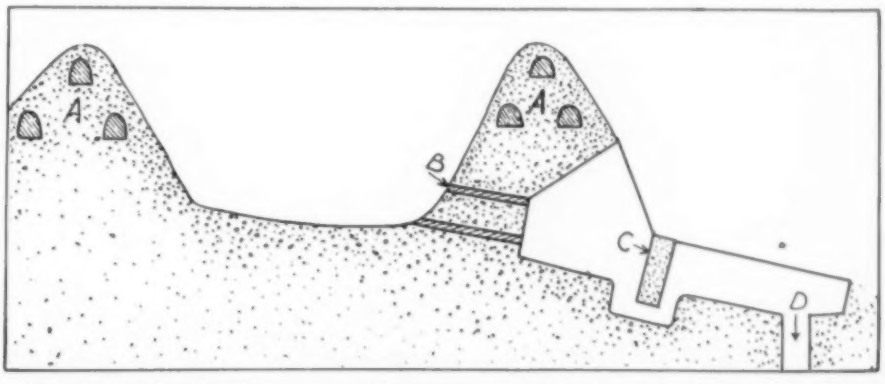


Fig. 29—Sectional View of an Emergency Reservoir with Skimming Spout Leading to the Sprue

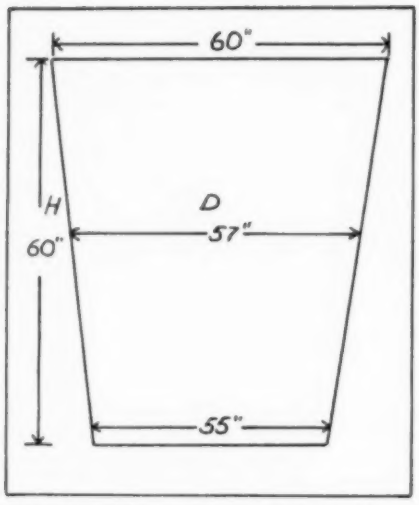


Fig. 30—Diagram to Assist in Figuring Ladle Capacity

distance or height in the mold.

Incidentally it may not be out of place here to present a short cut rule for estimating the holding capacity of a ladle, in whole or in part, or, for estimating the weight of any given amount of iron actually in the ladle. Square the diameter of the ladle and multiply the result by the constant 0.206. The resultant figure is the weight in pounds of a layer of iron 1-inch thick and the diameter of the ladle. To find the weight of the total amount it is only necessary to multiply the foregoing answer by the depth of the metal in inches.

Thus in a ladle shown in Fig. 30, with all the dimensions taken inside the lining, the mean diameter is 57 inches and the height is 60 inches. The formula for finding the capacity of this ladle in molten iron therefore is as follows:

$$D^2 \times 0.206 \times H = \text{capacity}$$

Where D is the diameter and H is the height. In figures this appears as: 57 x 57 x 0.206 x 60=40,158 pounds

The foregoing formula applies to any cylindrical body of iron. It is much shorter than the usual formula involving the squaring of the diameter, multiplying by 0.7854, then by the height and finally by 0.26 pounds, the weight of a cubic inch of cast iron.

Up to comparatively recent years the almost universal practice was to cut the gates by hand. Ordinary gates were formed by cutting a channel in the sand with a piece of tin, brass, copper, or steel plate bent almost double as shown in Fig. 31. One end, shown at the left, was pinched to cut a narrow passage. The other end illustrated at the right was designed to cut a wide shallow channel or trench in the sand.

Naturally, a gate cut in this manner left the sand in a rough condition. In some instances an effort was made to smooth the sand with a tool or with the fingers, but usually after the gate was cut with the sheet of metal known as the gate cutter, it received no further attention.

For a wide range of castings, this type of gate served in a fairly satisfactory manner. A certain amount of loose sand was picked up by the stream of iron and carried into the mold. If this sand was scattered and did not show too prominently in any one place, it did not detract either from the appearance or the utility of the casting.

This type of gate is not satisfactory for castings which must show an unblemished surface after they are machined, castings which are to be coated with enamel, castings designed to resist pressure, or, to sum the varieties up briefly, perfect castings.

A skillful molder armed with a trowel, a lifter or a double ender can cut a gate in the sand, finish it and black it so that it will not deteriorate while the metal is running through it. Unfortunately the number of skilled molders is decreasing year by year. Also in keeping with the spirit of the age which insists on speed and then more speed, a molder is not given the time to cut a gate by hand and finish it properly.

Considering the fact that no gate cut in the sand with a gate cutter or any other tool is as perfect, as clean, as compact and as well able to resist the erosive action of the flowing iron as a gate formed by placing a suitable block of wood or metal next to the pattern and ramming sand around it, one is moved to wonder why the foundry industry still tolerates the old time method.

The set gate is not a modern device. No available data is at hand to indicate when this form of gate equipment first was employed, but certainly in one form or another it was employed for the past 100 years, particularly in stove plate, and hollow ware shops and in foundries devoted to the production of light or, small castings.

A desire to save time probably was the main reason for the early adoption of the set gate. On repetition work the saving in time amounted to a considerable item, but on single castings the expense of preparing the gate as part of the pattern equipment could not be entertained in comparison with the negligible cost of cutting the gate with a gate cutter.

Adoption of the follow board and match plate helped to spread the appreciation of the value of the set gate. However, the principal credit for the present wide spread use of the set gate is due the designers and manufacturers of molding machines. Working at times against actual opposition of those they proposed to benefit, these men have done as much if not more than foundrymen themselves, to raise the technique of mold making to its present high plane. Wherever they have been asked to furnish the patterns as well as the machines, they have incorporated a device for forming the gate. As a result the gate becomes an integral part of the mold with the same smooth, firm walls.

Another advantage of the set gate is that it may be designed and adjusted in place by an expert and in that manner removes one of the many variables involved in attempting to produce castings with untrained or at best semiskilled operators.

This is the sixth of a series of articles dealing with the various types of gates and risers used in the foundry industry. The seventh installment will appear in an early issue.—THE EDITORS.

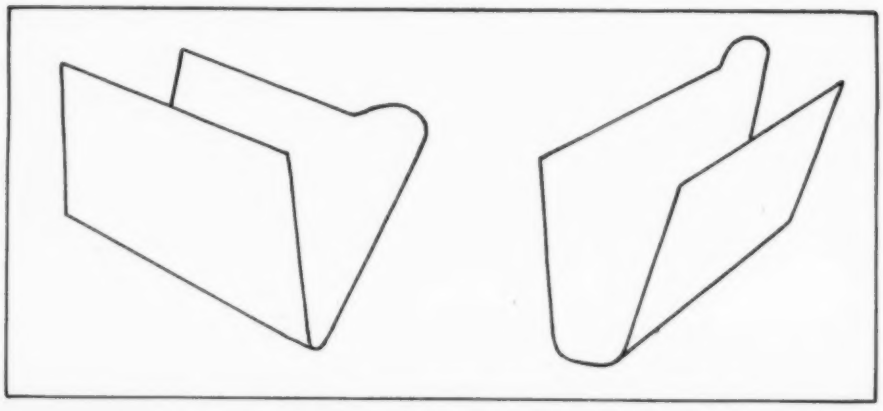


Fig. 31—Usual Type of Sheet Metal Gate Cutter with Wide and Narrow Lips

Brass Founders Meet

The regular monthly meeting of the Associated Brass Founders of New England was held Feb. 25 at the the Engineers club, 2 Commonwealth avenue, Boston. Ralph Underwood, research executive, New England council, addressed the meeting on "New England of 1950." He brought out the fact that New England with 2 per cent of the area of the country, had 8 per cent of the population. Industrial growth of that district from 1914 to 1931 has increased 135 per cent and railroads of New England have invested $180,000,000 in the past 5 years.

Purdue Research Foundation, Lafayette, Ind., recently was organized and incorporated to carry on research activities at Purdue University, Lafayette, Ind.

Synchronization of Equipment Aids Material Handling

By William C. Babbitt

TEAMWORK in industry, like a coin, has two sides. One side of the problem deals with the co-operation of personnel, a section which has received a large amount of attention. The other and equally important side dealing with the proper synchronization of equipment has not received as much scrutiny. One part of the latter division, the part in which many foundries are interested, deals with team work in materials handling equipment.

Two main qualifications for equipment team work are as follows: The apparatus must do its part of the job well and it must assist other equipment in such a way as to make the material handling system efficient. Many progressive foundries have given much thought to synchronization of handling equipment and Richardson & Boynton Co., Buffalo, is typical of that group. That company manufactures steam and hot water furnaces and household hot water heaters.

The plant consists of several units including foundry, machining and testing departments, and a building housing the core room, cleaning department, engine room, boiler room and locker room. A small section extends from the foundry unit, in which offices of the company and a testing room are located. The main foundry building extends at the right of the office. To the left, the unit housing the coreroom etc., and the stock yard are located. The stock yard, approximately 200 x 100 feet, is located directly at the rear of the cupolas and is bounded on two sides by the railroad siding and on the others by the main foundry unit and the building housing the core room, cleaning department, etc. Incoming materials are stored in bins. The area is served by an overhead crane equipped with grab bucket and magnet. The craneway extends across the siding to an additional area used for sand storage.

Coke and iron hoppers for loading charging buckets are located at the end of the yard nearest the cupolas. Those hoppers are shown in Fig. 2. An electric truck is shown bringing a coke charge from the hoppers. Total material charged daily averages 60 tons. Individual buckets weigh 2500 to 2600 pounds. The average haul from iron hoppers to

Fig. 1—Ladles Are Run Up to the Spout on Trucks. Fig. 2—Trucks Haul Coke, Scrap and Pig Iron for the Charges to the Cupola Hoist

Fig. 3—Trucks Are Used To Bring Castings from Storage and To Move Various Items Ready for Shipment To Cars or to Motor Trucks

hoist is about 60 feet and from the coke hoppers to hoist about 100 feet. The truck shown in the illustration handles all the buckets between the hoppers and hoist and is one of five, low-lift, electric, industrial trucks operated by the company. The equipment in the yard fulfills the first qualification of material handling equipment but not the second. Each piece of equipment handles its individual job well but the system is not conductive to the various parts aiding each other.

The core room handling system fulfills both requirements of a material handling system. Cores are transported to, and placed in the ovens by cars on transfer tracks, by hand trucks and by electric trucks. The baked cores are taken from the ovens to the foundry by electric truck. Minimum haul is 200 feet and the maximum 650 feet. The average distance is 350 feet.

Cupolas are located along the left wall of the foundry approximately at the center. Two crane runways, each with a 40 foot span and 300 foot traverse, run the length of the building. In addition, the runway of one crane extends 160 feet into the yard to serve the flask storage area. These cranes serve the central portion of the foundry but sections approximately 30 feet wide on either side of the runways do not have that service available. Those divisions are served by air hoists. While the layout using two cranes probably permits better service than if the area was served by a single crane, the former method leaves a gap between the crane runways. Two electric, industrial trucks transport all material from one runway to the other, thus closing the gap.

An interesting example of handling equipment team work is exhibited by the electric, industrial trucks and the electric overhead cranes handling hot metal. The accompanying diagram showing the method of handiing materials in the foundry illustrates the proportions of metal that may be handled by employing either crane, truck or varying amount of service of each piece of equipment. The electric truck is a flexible piece of apparatus and it is for that reason that the company depends upon that type of equipment to eliminate any inequalities that might interfere with prompt handling of hot metal.

It is regular practice to fill the ladles on truck platforms as shown in Fig. 1. Smaller ladles, within the capacity of the various air hoists and hand ladles, are taken direct to the required points by truck. When a truck has a large ladle on its platform it moves under the proper craneway. The crane usually is either ready or on the way to meet the truck, thus removing the ladle with little or no delay. The crane serving the area in which the cupolas are located also can pick up ladles direct from the spout, adding further to the flexibility of the system. However, the trucks generally handle all except small hand ladles used in the

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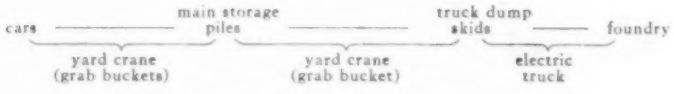
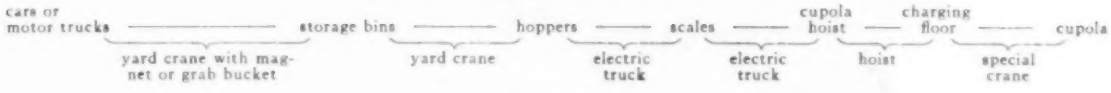
Principal Foundry Handling Operations

Core Sand and Cores

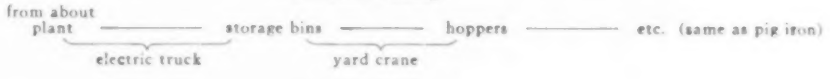
Molding Sand



Pig Iron, Coke, Foreign Scrap

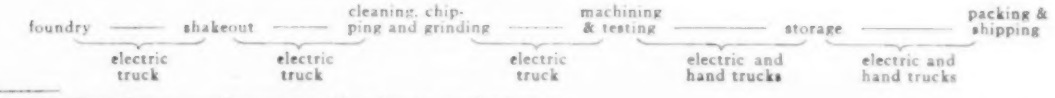


Local Scrap



*Hot Metal

Castings



*Area A—Area close to cupolas not served by electric, overhead crane.
Area B—Area nearest cupolas served by electric, overhead crane.
Area C—Area furtherest from cupolas served by electric, overhead crane.
Area D—Area on far side of building from cupolas not served by electric, overhead crane.

A. F. A. Prepares *Technical* Program for CHICAGO Meeting

PRELIMINARY reports of the technical program for the Chicago convention of the American Foundrymen's association, indicate an exceptional array of speakers presenting information on a variety of pertinent foundry problems. In addition to the extraordinary list of formal papers, Technical Secretary Robert E. Kennedy has provided the most ambitious program of shop operation courses and round table sessions yet attempted by the A. F. A. The technical sessions and the exhibit of foundry equipment and supplies will be held in the Stevens hotel, Chicago, May 4 to 7.

Of the many papers to be presented at the convention, three will be contributions from representatives of European foundry associations. V. C. Faulkner, editor, *Foundry Trade Journal*, and a past president of the Institute of British Foundrymen, will present a paper reviewing the British foundry industry. This will be the exchange paper presented on behalf of the I. B. F.

Major Nicolau of the French war office will present the exchange paper of the French Foundry Technical association, his subject being "Testing Cast Iron."

J. Dessent and M. Kagan will present a paper entitled "A Contribution to the Study of the Part Played by Phosphorus in Cast Iron" on behalf of the Belgian Technical Foundry association. Mr. Dessent is connected with the University of Liege and Mr. Kagan is metallurgical engineer and manager of foundries of the Bressoux Foundries of Liege.

Foundry costs will be discussed at two sessions. The first session will be devoted to nonferrous foundry cost problems and will be addressed by Mr. Baker of the E. A. Baker Corp. of New York. The second session will be devoted principally to discussions of reports of two subcommittees of the A. F. A. cost committee. The first report will deal with the developing of standards outlining information which should be supplied to the foundries by the purchasers when requesting estimates. The second will deal with methods for determining molding costs.

Papers on apprentice training will show what should be done to establish community training programs and how related instruction can be carried on. The first of these papers will be presented by H. A. Falk, vice president and work manager of the Falk Corp., Milwaukee, and the second by S. M. Brah, supervisor of apprentices of the Moline, Rock Island and Davenport district.

Extensive programs have been scheduled dealing with shop operation, metallurgical and production methods of nonferrous, steel, malleable and gray iron foundries. Three types of meetings will be held as follows: Shop operation instructional course, informal round table discussions and technical sessions.

For the nonferrous group, the shop operation course will cover gating. The papers to be presented will be on permanent molds, use of the X-ray to improve castings, improved brass foundry practice, etc.

The gray iron papers will cover several phases, such as production of high test iron, electric, powdered coal and air furnace melting, alloys, etc.

The steel foundry program will have, in addition to a shop operation course, a round table meeting and sessions with papers on steel foundry sands, comparison of electric steel and open-hearth steel, the relationship of pin-hole trouble and low ductility, electric furnace melting and centrifugal casting.

The malleable committee has prepared a larger program than ever before, with a round table meeting, a shop operation course, and papers on refractories, thermal balances, and production costs. An innovation will be the introduction of a shop operation course on fundamentals of sand control. A session on pattern production problems will also be a new feature of the 1931 meeting.

Progress in Methods Aids Die Casting Industry

By Marc Stern

SOME confusion exists as to the exact meaning of the term *die casting*, especially in the minds of those who have access to British literature on the subject, where the term is used in an entirely different sense as compared with accepted use in this country. The casting processes in metallic molds are subject to five variations, classified according to the method employed. These five processes are slush casting, permanent-mold casting, centrifugal casting, pressed casting and die casting.

A slush casting is produced by pouring metal into a metallic mold which is inverted almost immediately to expel or *slush* out the excess molten metal. A hollow shell or casting remains which has been chilled by and conforms to the surface of the mold. The thickness of the shell depends upon the mold and metal temperature and the time consumed before the excess metal is expelled. This method is used for toys and articles of a decorative nature, and complicated coring thus can be obtained in a very simple manner.

Processes Are Different

A permanent mold casting is produced by pouring metal into a metallic mold; the gravity effect of the head of metal in the gate is the only pressure used. Thermal conditions of the various mold sections are vital to success, and risers or chills must be considered from the standpoint of progressive solidification toward the gate.

Cored sections are produced either with metallic or sand cores. This process has a broad field of engineering application. The term *gravity casting* would be more appropriate for the process, because the word *permanent* has no place in any casting process where the wear and tear of molds must of necessity be quite a factor.

A centrifugal casting is produced by pouring metal into a rapidly rotating mold, the centrifugal action forcing the metal to conform to its shape before solidification. That process is applicable to practically all metals from babbitt to gray iron.

A pressed casting, also known as the Cothias process (after its inventor), is a casting in which a predetermined amount of metal is poured into the mold. A core or plunger is caused to descend rapidly into the mold, and the resulting force presses the metal into all sections of the cavity. It is applicable to simple parts of open design.

A die-casting is one formed by forcing liquid metal into a die or mold and maintaining the pressure until solidification is completed. In England such a product is identified as a *pressure casting*, and there the term *die casting* is a general term applied to all the casting methods previously mentioned.

It will be noted that in the first four methods of casting, the molten metal initially is introduced into the mold by *pouring*, while in a die casting the metal is *forced* in from the start, under the influence of either mechanical or gaseous pressure. This accounts for the fact that the first four methods produce a more solid internal structure by allowing ample time for the air to escape. However, the die casting process overcomes this disadvantage by producing castings of sharper outlines, thinner walls, denser surfaces and of much more intricate designs, where accuracy and finish are the most desired essentials.

Tin and lead alloys first were utilized in the production of printing type and later were applied to the die casting of other parts because they could be handled most easily from a casting standpoint. In spite of the fact that rule-of-thumb alloying methods prevailed, they were not subject to serious consequences. Their field of application outside of bearings was limited. Therefore the next step, was the production of zinc-base die castings because of the demand for something stronger and harder than lead or tin. Thereupon casting troubles multiplied. Pumping equipment deteriorated rapidly; thin sections would not fill up because of sluggish flow and, if they did fill up, a considerable percentage of die castings left the mold with visible or invisible cracks.

Many Troubles Overcome

To overcome these troubles the production foreman would add a little aluminum or copper, or perhaps would drop a bar of tin into the casting pot. If the cracks stopped, that combination was maintained for that particular job. The next die casting may have had heavy sections, causing the excessive tin to sweat out—then another combination was attempted. The supposition was that which produced the best casting was the best ultimate product, and little thought was given to possible instability of alloys. It is no wonder that, with such haphazard alloying methods, untold injury was done to otherwise meritorious products utilizing zinc die castings.

Clearances in such devices were found to disappear after a short time, particularly in damp and hot climates. Parts subjected to even light strains suddenly broke after a few months' use, and others cracked while standing idle on the shelves. These were manifestations of the usual troubles associated with any new industry.

From this chaotic state a better understanding of the properties of zinc alloys slowly developed. It was found that the combination of certain elements in zinc alloys, such as alum-

Castings Are Better

DURING the past decade, considerable progress has been made in equipment and methods utilized in the manufacture of die castings. In this article, which is abstracted from a paper presented at the Cleveland convention of the American Foundrymen's association, developments in methods of alloying are discussed and improvements in die casting machines are described. The author is manager of the die casting division, A. C. Spark Plug Co., located in Flint, Mich.

inum, in the presence of tin, lead or cadmium, produce unstable alloys. They are subject to excessive internal oxidation or growth, and the deterioration is accelerated by vibration, heat and moisture.

The importance of careful metallurgical control then was realized, but it was not until about 8 years ago that research worthy of the name really was started along this line. Zinc-alloy die castings now are produced commercially with a tensile strength of 30,000 to 50,000 pounds per square inch.

They also are sufficiently permanent for all practical purposes, as attested by the yearly production of hundreds of thousands of speedometers and similar devices in which clearances and spacings of moving parts are held to close limits. Zinc alloys of even greater permanency in physical properties now are in the process of development.

When one considers the marked effects produced on the properties of alloy steels by the addition of minute quantities of various elements, it is to be expected that similar investigations in the nonferrous field will bring about equally beneficial results in this comparatively new industry.

Die Maintenance Was High

Aluminum die casting was started commercially in 1914, and the selection of alloys from the standpoint of permanency was a comparatively simple problem, because of the experience derived from sand castings. The main difficulty was in the casting operation, due to the corrosive action of aluminum on the pressure containers. The higher temperature and greater shrinkage caused abnormally high die maintenance. Die-opening mechanisms also were so slow that the castings would shrink on cores until they cracked.

These difficulties have been reduced greatly by the proper selection of alloys, improved casting equipment and the use of alloy steels for die construction. The steels generally used for this purpose are chrome-vanadium and chrome-tungsten-cobalt steels, but there is still much room for improvement, on account of the surface cracks developed which mar the appearance of aluminum die castings made from old dies.

The die casting of brass thus far has not proved a commercial success in this country, although it is used in limited quantities in Europe. The reason is that in a die casting one expects greater accuracy, in the casting of holes, threads, teeth, etc., so as to reduce subsequent machining to a minimum. However, such details quickly are destroyed by the greater shrinkage, higher temperature and rapid flow of molten brass, with the result that the high cost of die maintenance offsets the saving on the castings. Success in this branch will come with the development of more durable steels. Permanent-mold castings in brass are commercially produced with apparent success, but they have a limited field of application.

The highest type of skill is needed in the workmanship of a die, especially when an intricate or accurate die casting is required. The impression must be polished free from tool marks or slight undercuts. However careful the workmanship, or however modern the casting machine may be, best results will not be secured unless the die is designed with the casting and the cleaning ends in view.

The parting, the gating, the venting, the location of the water-cooling channels and even the location of the ejector pins, have an important bearing on the result. It is difficult to reconcile, for example, the theoretical form of gate, which sometimes is subjected to considerable modification before a good die casting is produced.

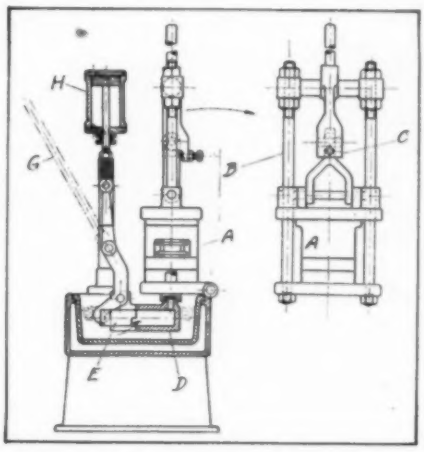


Fig. 1—Early Die Casting Machines Required Considerable Manual Labor

One would expect that, in die casting a medium-sized flat plate free from holes or bosses, the gate should be led in gradually along the entire length of one edge and good results thus assured. Yet it is much more difficult to fill such a casting than if a number of holes or bosses are added. Such surprises make it difficult to establish general rules in the design of dies. Experience is the only safe guide, and it is the accumulated experience of the past years that makes possible the production of large and complicated die castings in aluminum, and in the lower-melting-point alloys.

Great progress also has been made in the design of die-casting machines. Fig. 1 illustrates an early type of production machine, with the frame *B* containing the die *A* swung into the the casting position. By the use of toggles *C* the frame locks the die securely. The whole frame is held against the nozzle of the pressure chamber by suitable locks, not shown on diagram. The pressure chamber *D* is stationary and submerged in a pot containing the molten metal. By pulling the long lever *G* (indicated by dot and dash lines), the plunger *E* forces the metal into the die. The frame then is swung to a horizontal position and opened to remove the casting. Ordinarily, it takes two men to swing the frame and operate the various levers on the die. One man or, for larger work, two men were needed to pull the plunger lever.

Early in 1914, the first real effort was made to eliminate this strenuous manual work; the air cylinder indicated at *H* was adopted to replace the hand lever in forcing metal into the die. At first it met with serious opposition, because it was reasoned that it could not duplicate the *feel* of hand pulling, which formerly could be varied with different jobs. However, this objection was due more to the mental inertia of old habits, and the change soon generally was adopted in the industry. Today the air cylinder is still in use on the plunger-type casting machine, together with the swinging-type frame, thus reducing the number of operators to two men, or, for simple dies, to one man.

Develop Automatic Machines

As the dies increased in size, swinging the frame became a real hardship, and the horizontal type of frame came into use. The frame is operated by an air cylinder through a system of toggles, as illustrated in Fig. 2. The pressure chamber also was modified to the gooseneck type, *A* in Fig. 2, in which air is applied directly on the surface of the metal in place of the plunger, and this construction is best suited for aluminum die castings This type of frame, with minor modifications and in conjunction with either a gooseneck or a plunger-style of pressure chamber, also is widely used in the industry today.

The industrial inactivity shortly after the war directed attention to further study of economical production. It was reasoned that, it being possible to apply power to the plunger and the frame independently, it surely ought to be possible to apply power to pull cores and eject the castings from the die. The result has been that we now have motor-driven, automatic die-casting machines that produce die castings in one continuous cycle, or series of cycles.

In a recent invention, based on a principle different from those previously described, the heavy portion of the die, known as the ejector die is stationary, and the cover die which is considerably lighter, is movable. This is the reverse of usual practice, and is said to provide better alignment of dies and more substantial rigidity in operating the core and ejector mechanism which are in the stationary die. The air cylinder operates the plunger, thus forcing the metal through the center of the cover die. This unit and furnace are supported by the saddle which moves

away from the cover die as it is being opened. This protects the die from absorbing an excessive amount of heat by radiation from the furnace. Another advantage of the movable furnace is the fact that it can be replaced quickly by another unit kept for emergencies in case of breakdown of the furnace lining.

The mechanism for pulling cores in the cover die easily is adjusted and operated, as are cores in the ejector die. All of the operations—such as the opening and closing of the die and nozzle, withdrawing or inserting cores in either die, applying and relieving the pressure on the metal and ejecting the finished die castings—are controlled automatically throughout

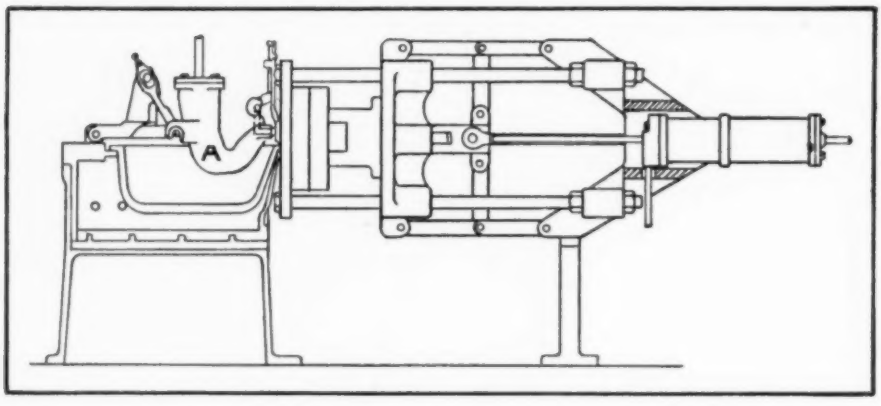


Fig. 2—The Horizontal-Type Frame Eliminates Laborious, Hand Swinging and Is Operated by an Air Cylinder Through a System of Toggles

a complete cycle, with the operation of a single lever.

With such automatic casting equipment it is possible to double and treble production over that of the hand-operated casting machine, and it is not unusual to produce complicated die castings at the rate of over seven operations per minute. Such production widens the field for die castings because it now is possible to produce parts which formerly could be produced more cheaply by other methods. The most desirable development, however, is the transformation of the casting equipment from a hit-or-miss proposition to one in which the personal equation of the operator is reduced to a minimum.

Concerns which, in the past, have established die-casting departments in their own plants, usually met with failure because of the necessity for highly specialized casting operators, and also because of frequent and costly replacements on the casting equipment. Early equipment was made entirely too light and too crude in construction to stand up.

It was not realized that pressure strains in the die often exceed 1000 pounds per square inch, and parts were proportioned barely strong enough to hold this pressure. However, mass also is needed for rigidity if accurate die castings are desired, for the same reason that machine tools are constructed along massive lines for precision work.

It also is a notorious fact that many concerns whose names stand out in the public mind as symbols of progressiveness and efficiency, usually have a small department with antiquated die-casting equipment. The same management that would not hesitate to scrap a battery of good screw machines for new equipment, which would reduce the operation time by a second or so, still will cling to die-casting equipment which was considered obsolete years ago. No doubt this is due to lack of familiarity with the process and its possibilities, and because of the rapid development of the industry in its methods and equipment. Modern die casting equipment would save time and money.

Research Laboratories Are Listed

The fourth edition of the bulletin of industrial research laboratories of the United States recently was issued by the National Research council, Washington. The publication, bulletin No. 81, lists alphabetically some 1625 industrial research laboratories in the United States, which is an increase of 60 per cent over the research laboratories listed in the 1927 edition of the bulletin. The main portion of the publication is devoted to a list of laboratories giving such data as: The company maintaining the laboratory; the number of men and positions held on the research staff; a brief outline of the research work under way and contemplated; and the development work and products of the company. A list of directors of research is included giving the address of each research director. A geographical index of the laboratories listed, and a subject index of the types of research are valuable features of the bulletin. Copies are supplied by the publication office of the National Research council, Washington, for $2.00.

Aids Material Handling

(*Concluded from Page* 52)

immediate vicinity of the cupolas. The handling system still necessitates that all heavy ladles intended for the area served by overhead cranes be picked up from the truck platform. However, that operation may be conducted at some convenient point away from the spout area. In 40 per cent of the foundry area not served by overhead cranes, trucks deliver ladles either to one of 10 air-hoists or to the various floors for hand pouring.

Experience with electric trucks co-operating with cranes and hoists in this type of work has been exceedingly satisfactory. Metal is removed speedily and is made available for use quickly, with a saving in productive time. No difficulty has been experienced with spills. The electric truck motor with its high initial torque provides safety where smooth starting and steady power are important.

Handling cores, sand and molten metal is not the extent of the service trucks perform in the foundry. They move castings to shakeout and cleaning rooms and cleaned castings to the machine shop and testing room. Both hand and power trucks are used to transport machined castings to storage. Electric trucks and the yard crane co-operate in the disposal of burned sand and refuse. Trucks collect that material and take it to a yard pile as a part of their regular duties.

The crane loads the refuse into motor trucks which take it to the dump. Trucks also are called upon to perform a considerable amount of what might be called *odd job* handling. This includes miscellaneous handling duties such as moving machinery, tanks, flasks, various items to and from repairs, aiding millwright service, etc. Trucks also aid in shipping. They are used regularly in co-operation with hand trucks in bringing castings, etc. from storage and in moving items ready for shipment to cars or motor trucks.

Handling of molten metal, the heavy overloads and exposure to heat, dust, sand and other abrasive materials tends to hasten the wearing of all moving parts of foundry equipment. Other unfavorable factors contribute to short life and high upkeep.

Performance, economy and upkeep of electric trucks in the Richardson & Boynton plant have been satisfactory. The oldest truck of the five now is engaged actively in its tenth year of service. Maintenance and operating costs on trucks have been low. While no separate metering has been practiced power consumed for charging batteries for a full day's service is known to be not in excess of 25 cents per truck per day.

The FOUNDRY Family Photograph Album

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Upper Left

A. J. E. LARSON

Art Metal Construction Co., Jamestown, N. Y.

Upper Right

J. T. MACKENZIE

American Cast Iron Pipe Co., Birmingham, Ala.

Lower Left

D. G. ANDERSON

Western Electric Co., Chicago

Lower Right

V. S. NEISSER

American Engineering Co., Philadelphia

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

REGULATIONS FOR THE INSTALLATION OF

PULVERIZED FUEL SYSTEMS

(Continued from Data Sheet No. 852)

Indirect driers delivering directly to the mills shall be run empty before cutting-out the mills, and coal gates, gas gates, or steam heating valves shall be shut tightly. If it becomes necessary to shut down the mills for any reason for more than twenty-four hours, the driers should be emptied.

In cases of indirect drier fires, shut-off coal inlet and outlet gates, gas inlet and outlet gates, and steam heating valves, if steam heated, and turn on steam or inert gas extinguishing lines.

Note.—When opening up a drier, transport line or other apparatus which has been sealed to extinguish a fire in the coal, or any place where live steam has been injected for the same purpose, precautions must be taken to prevent ignition of any gas which may have been generated during the period of the fire.

After the fire has been extinguished and the coal has been cooled below ignition temperature, the drier should be ventilated with a vigorous current of fresh air for ten minutes or more to remove poisonous gases before persons are allowed to enter.

(c) Whenever a plant has been idle for a period of two days or more, all storage bins shall be thoroughly inspected before resuming operation.

(d) Manhole or inspection openings of furnace bins shall not be open while fuel is being discharged into the bins.

(e) Operators are cautioned against causing leaks in pipe lines or bins by hammering.

(f) Damper in drier chimney uptake shall be wide open when fire is started.

(g) In *Class B* system, if fuel supply line becomes clogged, the furnace shall be immediately cut off and the secondary air stopped. When obstruction has been cleared and before starting fan, a thorough examination shall be made to ensure the removal of smoldering particles of fuel.

(h) All fuel supply lines (of *Class B* and *Unit System* types) shall be blown clear of fuel when shutting down at end of day.

(i) All conveyors and elevators shall be tightly and securely enclosed and never opened while running. All conveying and distributing piping shall be inspected daily and any leaks promptly repaired. Previous to opening machinery shall be stopped and dust allowed to settle for a period of 20 minutes.

(j) Only daylight or hand flashlights shall be used when inspecting the interior of coal storage bins and pulverizing and coal conveying apparatus when in operation. When apparatus is not in operation guarded drop-lights with dust-proof globes utilizing cord approved for hard usage such as type *S* or *PA* may be used. Portable cord shall be used only from approved convenience outlets provided for this purpose.

(k) Smoking and the use of open lights or torches shall be prohibited in the crushing, drying and pulverizing plant.

(l) LIGHTING PULVERIZED FUEL FURNACES. Before injecting pulverized fuel into a furnace:

1. See that there is sufficient draft on the furnace to adequately remove the products of combustion.
2. Provide lighted torches, adequate in number and volume of flame, so disposed as to ignite all burners to be started.

Keep the torches in operation until all danger of losing ignition has passed.

NOTE.—Many explosions resulting in loss of life and property have occurred due to improper lighting-off practice. The requirements of a safe lighting-off system vary so widely with coals and equipment having different characteristics that universally applicable detailed rules cannot be written. The following suggestions are offered as representing good ignition practice.

1. Permanent oil torches should be installed according to the Regulations for the Installation of Oil Burning Equipments.

(Continued on Data Sheet No. 854)

REGULATIONS FOR THE INSTALLATION OF

PULVERIZED FUEL SYSTEMS

(Continued from Data Sheet No. 853)

2. Low-viscosity, high-flash-point oils such as kerosene or gas oil are recommended.

3. Torches should have a supply of air under pressure independent of furnace draft.

4. Portable torches, with which the tank and piping are not in accordance with codes for oil fired plants, should be withdrawn from the furnace completely when not in use.

5. No gas having less than 400 B.t.u. per cubic foot is to be used for an ignition torch, except that in furnaces fired primarily by blast furnace gas, having coal burners only for use in emergencies, the gas may be used as a lighting medium for the coal if the two types of burners are located according to the best practice.

6. All gas torches should have a supply of air under pressure independent of furnace draft, or should be arranged like a Bunsen burner with the gas under sufficient pressure to induce its own air supply.

7. The size of each torch should be proportioned according to the size of the coal burner.

8. Each torch should preferably be located so that its flame will approximately parallel the coal stream to obtain contact for an appreciably lengh of time with a given mass of coal.

9. The torch should be so located that the tip and ignition zone are outside of the coal stream to avoid danger of having the torch snuffed out.

Table III

STORAGE TIME FOR CRUSHED COAL

Temp. of coal entering mills	Max. time for storing pulv. or dried crushed coal
Semi-Anthracite Coal	
200 degrees Fahr.	12 hours
175 degrees Fahr.	16 hours
150 degrees Fahr.	24 hours
140 degrees Fahr.	36 hours
130 degrees Fahr.	One week
Bituminous Coal Containing Less Than 2 Per Cent Sulphur	
180 degrees Fahr.	12 hours
150 degrees Fahr.	18 hours
130 degrees Fahr.	24 hours
120 degrees Fahr.	One week
Lignite, Sub-Bituminous and High Sulphur Coal	
150 degrees Fahr.	12 hours
130 degrees Fahr.	16 hours
120 degrees Fahr.	24 hours
110 degrees Fahr.	36 hours
100 degrees Fahr.	One week

APPENDIX A

STORAGE OF COAL

The observance of proper precautions in the storing of pulverized or dried crushed coal is of pronounced importance in that failure in this respect will probably result in fire due to spontaneous ignition. In order to safeguard against this hazard it is urged that the advisory requirements given in Table III be complied with.

The last group of coals because of their higher inherent moisture will

(Continued on Data Sheet No. 855)

Use of Foreign Scrap Is Fraught with Danger

Elements in Many New Nonferrous Alloys Have Deleterious Effect on Old Standard Mixtures

By J. F. Buchanan

AT NO time in the history of the metal industry has there been such abundance of scrap and secondary metals and alloys available as at present. Intensive research in metallurgical problems, improved practice in alloying processes, and the enormously increased use of comparatively rare elements in the production of new alloys to meet the developments of modern science and engineering, have contributed to this abnormal surplusage of scrap metals Consequently, the problems of identification, classification and reclamation of nonferrous alloy scrap become more involved and demand more expert knowledge and treatment as time goes on.

Alloys Are Complex

The chief reasons for this are the multiplicity of complex alloys that have been standardized by various authoritative bodies and the great number of what might be termed experimental alloys, displacing the older standards in alloying practice. When it is considered that not so many years ago the bulk of nonferrous alloys were composed of five, or at most, six metals, namely, copper, tin, zinc, lead, nickel, antimony, (with aluminum gradually coming into prominence) it can be understood how simple a matter it was for the brass founder of former days to make castings from scrap metals without trouble.

The modern tendency to experiment with alloys, to adapt metal products to the progressive changes in engineering practice, and to meet the chemical and mechanical requirements of newer and more scientific methods in industry, has led to the introduction of many elements in alloys that formerly were looked upon as rare, or at least, outside the ambit of operations in the foundry or the fabricating plant.

Injurious effects of some of these later additions to alloys, when introduced, as scrap, into the older standard mixtures, have given foundrymen untold trouble. Miscellaneous scrap cannot now be used with any degree of confidence or success in the production of even the most ordinary castings.

Where a specification is agreed upon, it has become imperative that virgin metals be used if exactitude in the chemical composition and physical conditions are to be attained. Modern metallurgy has provided us with metals of the highest degree of purity, and with these there should be no difficulty in meeting all the technical requirements within the scope of the formula. The foundryman who, for the sake of a small saving in the cost of metal, takes chances and puts *foreign* scrap in a mixture of this kind, may become vulnerable to many troubles. In addition, he is playing fast and loose with the greatest asset of his business—a reputation for honest service.

Because of the great variety of new metals entering into alloys and the difficulty of distinguishing elements that may be harmful outside of their own combination, no class of alloy scrap can be taken on trust. If the origin of the scrap is unknown, the contents are likely to be more so, even when it has the appearance of some well known grade of metal. Hand sorting of alloy scrap is a thing of the past. The old empirical tests by color, fracture, filing, heating or bending assuredly would fail to assign the proper classification or use of modern alloy scrap, either for the rolling mill or the foundry.

New Elements Introduced

Beginning with copper for example, by the free use of cadmium-copper in the electrical trades and cadmium and chromium plating in other industries, new elements have to be considered in association with copper scrap. If this scrap is to be utilized in making even secondary alloys the effect of those foreign metals has to be understood and if necessary guarded against.

So many new elements have been added to copper base alloys, some with the object of increasing resistance to corrosion, heat, or electricity, others with various mechanical potentialities, that collected brass and gunmetal scrap, although it may be graded as to size and form, cannot be classified with the ordinary range of alloys. High tensile bronzes, acid and heat resisting alloys, plastic bearing bronzes and electrical alloys cover a wide range of metals in admixture besides copper, tin, zinc, and lead. It is possible that there might be as many as 20 elements present in these alloys and each alloy in its class would be superior, but a mixture of all, as might be represented in collected scrap, would play havoc with the production of any brass foundry.

Sampling Is Necessary

The importance of proper sorting and sampling of every parcel of miscellaneous brass and gunmetal scrap intended for re-use in the foundry must be obvious. Indeed it would not be safe for any foundry to buy mixed metal scrap unless of standard composition. Names have lost all significance when applied to alloys. Gunmetal is a term of such loose interpretation today that almost any copper base metal can be classed as such if it has a certain reddish appearance and takes a nominal brinell impression.

Babbitt metal is the most degraded term in the metal trade. It fluctuates anywhere between type metal and plastic tin. Nickel silver alloy as turned out in some factories has a white color, but does not necessarily contain nickel. It is the unexpected or unassimilable element that upsets the balance of the mixture for foundry purposes. For example, railway engineers have vindicated the use of leaded gunmetal for bearings, but get aluminum in this mixture and trouble begins.

Similarly with lead alloy scrap which, in recent times, has had many unfamiliar additions made, such as lithium, calcium or other earthy metals, in so-called antifriction metals or zirconium in type metals, or sulphur in copper-lead packings. The usual description for lead alloy scrap would fail to indicate the proper use of such material.

Monel metal and nickel-chromium alloys have also added new features

to the scrap pile which are confusing. The similarity in appearance of some of the stainless steels to monel cuttings is so remarkable that only by chemical test, proving the absence of copper, was a stainless steel separated from the monel metal in a recent consignment. However, it is when we begin to handle aluminum alloys that the real struggle of classifying begins.

To mention only one class of scrap—a heap of miscellaneous aluminum pistons would give quite a long stretch of employment to a research chemist to determine all the elements it contained, so numerous and involved are the combinations in this particular class of material. If that heap of pistons was to be melted together in one heat, the resulting metal would be a nightmare to any self-respecting foundryman.

Chemical Tests Made

So far we have only mentioned alloy scrap as metal, but there are other forms of material from which the metals have to be extracted, refined, and in some cases reconstituted, before they can be utilized or reclaimed. The recovery and reconditioning of metal wastes and residues, borings, grindings, swarf, skimmings, drosses, foil and oxides, present numerous metallurgical problems varying with every class of material. This material cannot be dealt with satisfactorily in small parcels and it is only by careful sampling and analysis and specialized treatment that profitable recoveries can be made. Before a value can be put upon any metal residues it is necessary to obtain a representative sample (usually by repeated quarterings) and an analysis of the reduced metal. The result determines the price, and the after-treatment of the bulk.

Aluminum residues are probably the most difficult to reduce. All aluminum has a film of oxide on its surface, heavier on old metal than on new metal and proportionally higher on small particles than on heavy pieces. The economical recovery of this metal requires special treatment. Borings, grindings and sawings should be briquetted. Skimmings should be ground, screened and freed from iron. Cast iron pots may be used in the melting provided they are lined with a wash of some protecting material, usually whiting mixed with silicate of soda. The pot should be about one-third filled with molten metal at about 1200 to 1240 degrees Fahr. into which the fines are rabbled, a little at a time until the metal assumes a pasty condition, one of the alkali fluorides being used as a flux.

When the pot is three-fourths filled, the heat is allowed to permeate the mass, but the temperature is not increased, and care should be taken not to soften the puddled metal unduly. At this stage another addition of flux, cryolite and zinc chloride, or salt is made and a final addition of fines is spread on top. The furnace is closed and metal allowed to heat through, the temperature being regulated as indicated. When the whole mass is thoroughly heated it is puddled and lumps that form are broken up and stirred into the bath. A little sodium or more flux is added; this causes the dross to glow, with a tendency to ball up. Constant stirring and breaking up of the balls goes on until the scum becomes powdery, when it is removed by means of a perforated ladle. The clean metal is then poured into ingots and analyzed for incorporation in secondary alloys. The recovery of ingot-metal should come between 60 and 80 per cent according to the quality of the scrap. Small, dirty, oil soaked chips give a low return whereas clean, large chips might yield as much as 85 per cent metal.

Of all the varieties of alloy scrap that come on the market, yellow brass scrap is the easiest to handle. It is a standard alloy and, if in the form of sheet cuttings, or rolled brass, rod ends, cartridge cases, or tubes, there is no difficulty in using it up again to advantage. But in the matter of mixed cast brass scrap the treatment is not so simple. Manganese bronze, delta metal, naval brass and a great variety of low grade mixtures are likely to make trouble if melted together. Plated metals fall naturally into a lower grade if nickel, chromium, cadmium, or tin are undesirable in the mixture. It follows therefore, that a miscellaneous collection of scrap can only be used to produce low grade metals unless it is put through the furnace, refined and an analysis taken as a guide for its further usefulness.

English Foundrymen Hear Linabury

The annual dinner of the Birmingham, Coventry and West Midlands branch of the Institute of British Foundrymen was held Feb. 7 at the Grand hotel, Birmingham, England. D. Wilkinson, president of the branch, was in the chair and the lord mayor and lady mayoress of Birmingham, Alderman and Mrs. W. W. Saunders, P. J. Hannon, M. P., Dr. D. Stirling Anderson, principal, Birmingham Central Technical college, and John E. Linabury, A. J. Brand, Inc., Detroit, also were present.

Mr. Linabury was welcomed by the president and proposed the toast of the Birmingham, Coventry and West Midlands branch. In his address he said that there seemed to have been good reason for the foundry industry to grow and progress in the Birmingham district, for it had the basic materials required by a foundry, namely, iron, coal, limestone and sand. Refractory clays for cupola and furnace linings also were located there. However, to make the foundry a successful institution, factors other than convenient raw materials and foundry knowledge were required. These included capital and markets. He stated that each foundry should consider its annual depreciation as part of the cost of castings and an amount equal to depreciation should be aside each year as a reserve fund. Too often all profits are paid out in the form of dividends and, after a period of years, the buildings are beyond repair and the plant is no longer able to compete with its more progressive neighbor. Mr. Linabury emphasized the fact that it was not profitable to keep an old piece of equipment when it could be replaced by a new piece which would pay for itself in a definite time, either by improvement in quality, saving in labor or floor space, or by making the working conditions better.

Another method of reducing costs is to maintain a close contact with the designing department. Too many castings are lost and too much time taken in manufacture because of ignorance of many designers of foundry problems. He stated that each operation should be studied to see that the equipment is in the proper location, of the most convenient height and in every way suitable for the work that is to be performed. Not only the individual operation, but its relation to those before and after should be considered. The proper perspective is required for such studies to see that the various operations are balanced evenly and not too much stress placed on one at the expense of others.

D. Wilkinson, president of the branch, responded to the toast. Dr. Stirling Anderson, principal, Birmingham Central Technical college, proposed the toast of the Institute of British Foundrymen. Cyril E. Lloyd, who supported the toast, said Birmingham had great interests in the industry. F. P. Wilson, president of the Institute of British Foundrymen, responding said that industry in Britain found its hands tied by taxation. The lord mayor of Birmingham responded to the civic toast.

Joint Committee on Education Meets

A meeting of the joint committee on foundry education in engineering schools was held recently in Cleveland. At that time plans were made for the recording of information on the physical properties of castings and proper design, which will be disseminated to engineering schools throughout the country. The data is to be prepared by the several organizations represented on the committee. A subcommittee also was authorized to prepare an outline for an ideal course in foundry instruction in engineering schools.

Fig. 1—Molds Move Along the Roller Type Conveyor to the Shakeout

POURS CARBURETORS With Electric Furnace Iron

By Carl E. Schubert

MELTING cast iron in the electric furnace and casting the resultant metal into various shapes and sizes is a more recent development of the modern foundry, and a number of companies have found this method of melting cast iron a profitable venture. One of the new electric furnace installations, together with all the necessary auxilliary equipment, was placed into operation last summer by the Bendix-Stromberg Carburetor Co., South Bend, Ind., a division of the Bendix Aviation Corp.

That corporation has built a new foundry as a part of the Stromberg-Carburetor company plant, in which many types of carburetors are produced. The most recent development is the use of cast iron for various parts of the carburetors.

The main divisions of the foundry are as follows: Sand handling and preparing equipment; electric furnace; molding floor; electric annealing oven; sandblasting department; grinding and finishing department; core room; and chemical laboratory.

The plant uses a special synthetic sand mixture, consisting of 100 pounds of molding sand, 100 pounds of Michigan City bank sand, and 40 pounds of clay bond, which has proven highly satisfactory. The sand is mixed to conform to the following physical properties: Permeability, 40 to 50; bond strength, 6 to 8 pounds; and moisture, 5 to 7 per cent. This sand produces a casting which is exceedingly smooth. It peels from the casting readily and there are no blows encountered which can be traced to the sand.

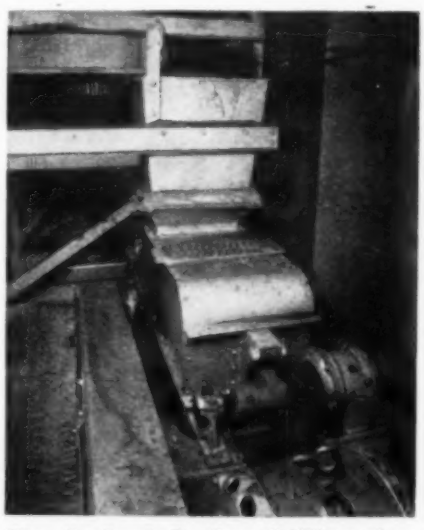


Fig. 2—Sand Is Passed Through a Revivifying Machine

The sand is stored in a large storage bin of 100 tons capacity which is part of the complete sand handling and conveying system installed by the Link-Belt Co., Chicago. The bin is located directly over a 1-ton muller type sand mixer built by the National Engineering Co., Chicago. Here the necessary water is added for tempering purposes. Other additions such as molding sand, core sand, and clay bond may be added conveniently.

After tempering, the sand is conveyed in elevators to a 10-ton cylindrical, revolving storage bin which feeds the sand uniformly to a revivifier, consisting of a high speed horizontal shaft upon which beater arms or paddles are mounted at an angle.

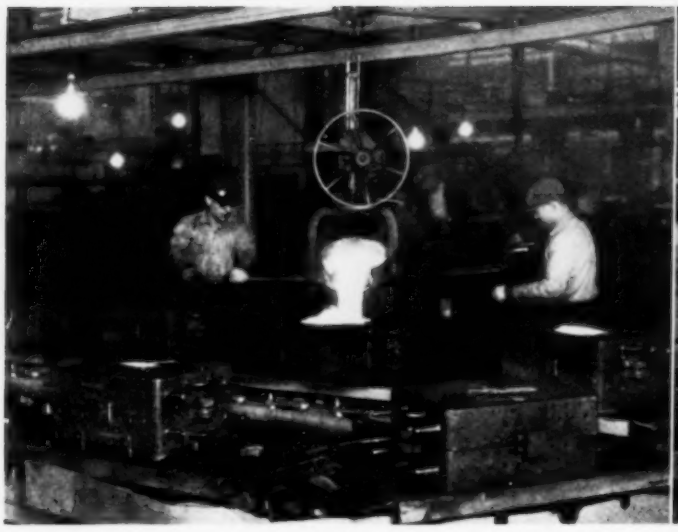


Fig. 3 (Left)—Pouring Gray Iron Manifold Castings on the Mold Conveyors. Fig. 4 (Right)—An Apron Conveyor Handling Castings in the Brass Foundry

The revivifier breaks up any lumps in the sand, and also aerates and cools the mixture. To prevent the sand from accumulating on the rods and inside of the housing, the rods and housing are jolted several times a minute by a cam driven through a speed reducer which in turn is belt driven from a beater shaft, as shown in Fig. 2. The sand which is ejected upon the belt from the revivifier is in condition for molding and is conveyed by belt conveyors, as shown in Fig. 6, to 1-ton hoppers on the molding floor. These hoppers are located directly over the molding machines, adding greatly to the ease with which the sand is handled by the molders. When the hoppers are full, any excess molding sand on the belt is carried to the storage tanks for use when needed.

The electric furnace, built by the Pittsburgh Electric Furnace Co., Pittsburgh, is shown in Fig. 9. The unit is mounted so that it may be tilted for charging and pouring, and is set over a pit. Pouring ladles are brought to the furnace on a monorail built immediately in front of the furnace. The electrodes of the furnace are lowered and raised automatically and are controlled by switches located on the panel board shown in the rear. The furnace is water cooled by an efficient water cooling system supplied with a safety break in the outlet water pipe, which immediately reveals any signs of bad water circulation through the cooling system. A convenient water trough also is located to one side of the furnace for cooling slag bars and the like. All metal to be charged into the furnace is stored in bins located in the furnace room, a part of the main foundry building but separated with a brick wall. The bins are 20 feet deep and the metal is picked up by a magnet and crane and placed on the charging floor to the rear and to one side of the charging door of the furnace. All charges are weighed carefully and a chemical analysis is made of all raw materials entering the furnace. Test bars for the chemical laboratory are poured at intervals and also chill test pieces. The chemical laboratory is situated about 50 feet from the electric furnace for convenience and time saving.

The method used to melt and pour the cast iron is known as the continuous melting process. Generally speaking this means that immediately after metal is removed from the spout of the furnace a charge equal to or sufficient to compensate for the metal removed immediately is thrown into the furnace. A charge consists of ap-

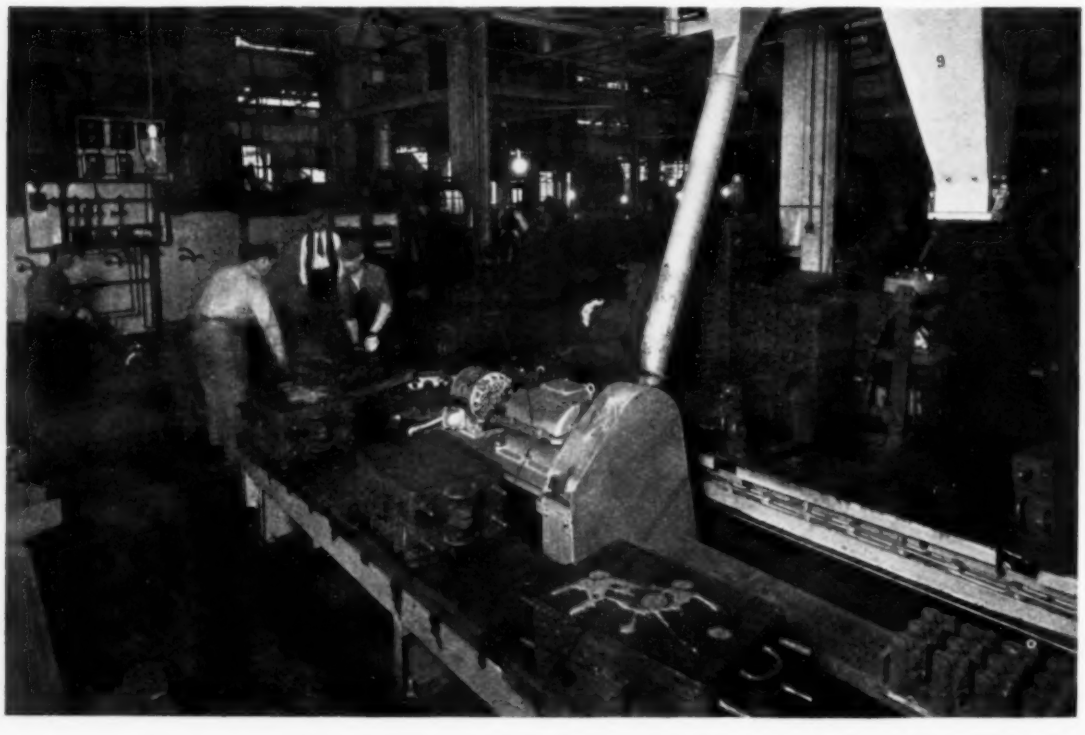


Fig. 5—The Roller Type Conveyor Carries the Poured Molds to the Shakeout and Returns the Flasks to the Molding Stations

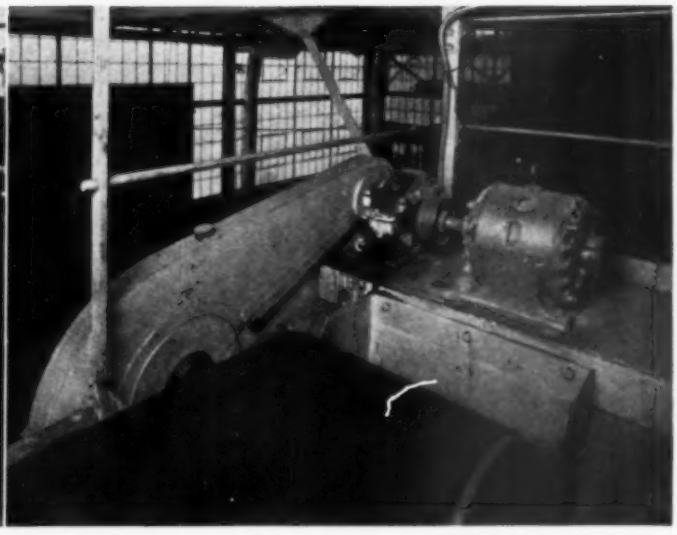


Fig. 6 (Left)—Prepared Sand Is Carried to the Molding Stations on a Long Belt. Fig. 7 (Right)—Driving Mechanism for the Distributor Belt

proximately 20 per cent pig iron, 70 per cent iron scrap and 10 per cent steel scrap.

After the metal leaves the electric furnace it is taken to the pouring station, a distance of approximately 40 feet. From 200 to 300 pounds of iron are removed at one time. The time elapsing between removing the metal from the furnace and refilling the ladles is from 5 to 6 minutes. It is during this time that slag is pulled, charges added, and metal is held at a sufficiently high temperature for casting purposes. The time elapsing between charging, pouring, and heating is so small that expert judgment of conditions existing in the furnace and a large amount of experience with electric furnace operation are required to produce castings of uniform quality. The metal is poured at a temperature of 2700 degrees Fahr.

Molding problems encountered when the system was placed in operation were the usual ones found when a pattern is run under new conditions for the first time. The number of jolts on the molding machine had to be determined, the method of placing the gates had to be tried out, shifts in the castings had to be prevented, and the problem of setting cores quickly and correctly while the conveyor was in motion had to be solved.

Molds are made on jolt ram, squeezer, stripper machines and placed on the conveyor as shown in the views of the main floor illustrated in Figs. 5 and 8. The molding machines were supplied by the W. H. Nicholls Co., Richmond Hill, Long Island, N. Y., and the roller type mold conveyor and vibrating shakeout was built by the Link-Belt Co., Chicago. Cores are set and the molds clamped while the conveyor is moving. From two to six castings are made in each mold. The speed of the conveyor is approximately 12 feet per minute. After the molds are poured they are allowed to travel to the opposite end of the conveyor where they are shaken out over a vibrating screen shakeout as shown in Fig. 1. The sand drops through to a conveyor belt and is carried to the storage tank previously mentioned. The vibrating screen loosens and removes the sand, and the gates and runners are broken from the castings. The castings are then piled for cooling and after cooling any remaining sand or cores are removed. They are then ready for the annealing oven.

Because sections as small as ⅛-inch thick are adjacent to ½-inch to ¾-inch sections in carburetors, and because many small holes have to be drilled and tapped, the castings made must

Fig. 8 — General View of the Foundry from Pouring End of Conveyor Unit. Castings Cool While Traveling the Length of the Conveyor

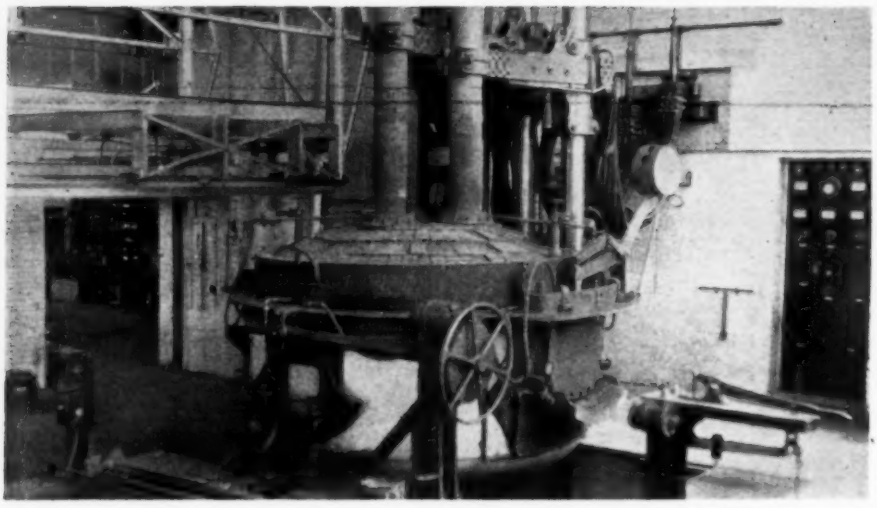


Fig. 9—Metal Is Melted in a 3-Ton Electric Furnace

be soft. There is no need for an iron of high transverse or tensile strength but the metal must be sufficiently close grained to prevent gasoline from passing through it. To guarantee soft castings, they are therefore annealed in an electric, automatically controlled annealing oven which was installed by the Electric Furnace Co., Salem, O.

The oven is of the zone type and the length of time the castings are in the high temperature zone will vary with the analysis of the castings, the range being between 8 and 15 minutes. The total time occupied for an annealing cycle is from 2½ to 4 hours, the remainder of the time being required in the first heating zone and in the cooling zone. The temperature at which the castings are annealed is 1550 degrees Fahr. To safeguard and produce castings which were of positive softness it was found that 2½ hours for the smaller castings and 4 hours for the larger castings was sufficient time to make soft castings. The trays travel along one side of the furnace for heating and are returned along the other side for cooling, a partition being constructed down the center of the furnace.

Two views of this oven are shown in Figs. 10 and 11. The castings are loaded on trays as shown in Fig. 10. An automatic, air operated ram pushes these trays into the oven. When the loaded trays reach the opposite end of the oven they are pushed to the opposite side with another air operated ram. The trays are then pushed through the cooling zone and discharged from the furnace at the same end as they entered. After the castings reach the outside of the oven they are unloaded from the trays and placed in metal barrels and are ready for sandblasting.

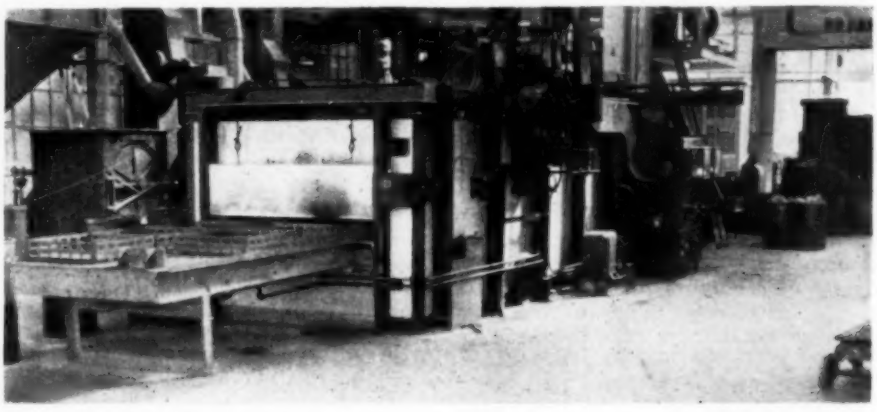


Fig. 10—End of the Electric Annealing Oven Showing the Trays in Position

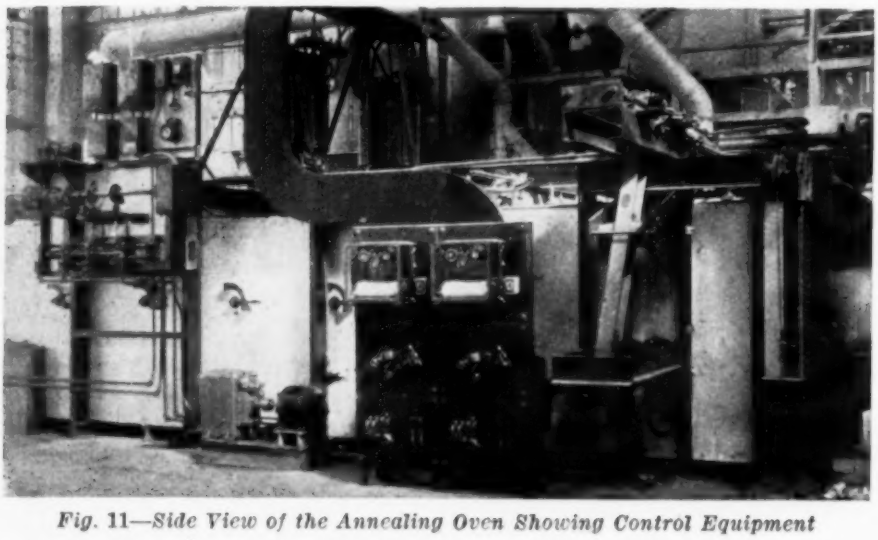


Fig. 11—Side View of the Annealing Oven Showing Control Equipment

Preliminary inspection of castings for blows and shifts is made at the shakeout before annealing. A closer inspection takes place after the sandblasting operation.

The castings are sandblasted on a revolving table type machine, using sharp silica sand. The equipment was installed by the Mott Sand-Blast Mfg. Co., Chicago. Tumbling barrels and cabinet type sand blasting equipment made by the Mott company, also are used; the latter on jobs that require extreme care. Gates are ground and fins are removed on high speed grinding machines which are located back of the annealing oven. The grinding equipment consists of polishers and grinders made by the Hisey-Wolfe Machine Co., Cincinnati, and disk grinders for flat surfaces, made by the Gardner Machine Co., Beloit, Wis.

Cores for the carburetor castings are made from various core sand mixtures, depending upon the size and shape of the core. The problem of suitable cores for an exceedingly smooth finish was solved by the adoption of the following formula: 70 parts by volume of Michigan City core sand; 2 parts of core oil; 1 part of water. This mixture produces cores with an average tensile strength of 75 to 85 pounds per square inch, which is of sufficient strength for the work demanded by them. The cores are easy to remove from the castings and the inside surface of the castings are extremely smooth and free from blowholes. All sand used in the core sand mixture is dried to prevent variations in weight of sand and produce cores of approximately correct strength at all times. Core sand is mixed in a 400-pound capacity machine made by the National Engineering Co., Chicago. The cores are baked in gas-fired, vertical-type, continuous core ovens equipped with an automatic temperature control. The ovens were supplied by the Foundry Equipment Co., Cleveland. The rammed cores are placed on core racks and conveyed

into the oven. The speed of the core racks in the oven may be regulated so as to bake cores for any length of time desired. All small cores are baked at a temperature of 425 to 450 degrees Fahr. for 45 minutes and large cores are baked for 1¼ to 1½ hours. A horizontal auxiliary oven is used to dry cores which have been pasted and assembled.

Core blowing machines made by Wm. Demmler & Bros., Kewanee, Ill., are used to make certain types of cores adaptable to them. Core sand is blown into the core boxes under approximately 120 pounds per square inch pressure.

The work of the chemical laboratory is of a routine nature. The department is equipped with the necessary apparatus to analyze for silicon, total carbon, graphitic carbon, manganese, sulphur and phosphorus. It also samples the molding sand at one hour intervals and checks it for moisture, bond strength and permeability. As pointed out before, a check of all raw materials entering the electric furnaces is made by the chemical laboratory, which insures adequate control and helps the melting operator of the furnace. It is a safeguard for the quality and the grade of iron for all the castings produced by the foundry.

Every effort has been made by the Bendix-Stromberg Carburetor Co. to use the most modern equipment and to provide a clean, healthy place for its employes to work. The foundry has concrete floors, it is well lighted, a modern system of heating and ventilation has been installed, washrooms are clean and sanitary, and safety in production methods is stressed constantly in all foundry operations.

Reader's Comment

EDITOR'S NOTE—*Material Appearing Under This Head Does Not Necessarily Reflect the Opinion of* THE FOUNDRY *or of Its Editors.*

He Likes Our Ways

TO THE EDITORS:

I recently have come over to your country to study foundry practice. For the past 16 years I have been working on the Continent, the Far East and England and I must say right away as far as foundry management and organization goes you have got the world beat to a frazzle. The other week I had the pleasure of seeing around some of the foundries in the Birmingham area and I take off my hat to the foundrymen of the South. The way the foundrymen, the engineers and the chemists get together is certainly a treat, and with one aim, i. e. "Efficiency" and cheap production. You are certainly a wonderful bunch of fellows.

I had the pleasure of attending the American Foundrymen's association meeting held in Birmingham and it was just a treat to hear the various foundrymen put forward their views on this and that trouble. One thing I did notice, American foundrymen prefer to use an iron with a low phosphorus content, while we in Britain and on the Continent and in the Far East, in fact, I may say the rest of the world, prefer a metal with a phosphorus content from 0.85 to 1.25 per cent and in most of the English foundries they like the phosphorus content above 1 per cent.

I gathered from the various chats I had with your foundrymen at the convention that it is their opinion that phosphorus is dangerous. They seem to take phosphorus control as a matter of great importance while we, on the other hand, are inclined to talk about the silicon in a similar manner. Silicon to us is the fellow that plays the mischief. We don't worry so much about the phosphorus and so long as it is in the region between 0.80 to 1.3 per cent we forget about it; but we do watch the silicon like a hawk watching its prey.

Your cupola practice is certainly far above ours at home. One of the foundries to which I had the pleasure of paying a visit had a 64-inch cupola melting day in and day out, 20 to 21 tons per hour over a 12 to 14-hour run with a 12 to 1 coke ratio. I saw pipes spun in iron molds, pipes spun in sand molds; 12-inch pipes 16 feet long made in green sand molds with a green sand core and no chaplets were used.

I saw many and many labor saving devices that would mean pounds in the pockets of the foundry owners if adopted in the old country. If there is an easy way in doing it you certainly have got it. If a machine can do it, you will certainly make it. No wonder you turn out three times as much per man per day as we do in the old country and the peculiar thing about it is none of you seem to work as hard as we do. Then you have your cupboards, your baths, your soap, towels, etc., and come and go to your work like gentlemen. I tell you when I saw the workmen come out of a large foundry the other day I thought they were all office hands. No one would think they were the laborers.

I have made castings of all types, including high class marine engines, textile machinery, drop stamp blocks, pipes both large and small, railway material, castings varying in weight from one pound to 53 tons with a phosphorus content ranging from 0.85 to 1.5 per cent. But, of course, as you will understand I varied the silicon from 0.8 per cent in the heavy castings to 2.5 per cent in the textile and light castings.

Truly you are miles ahead of us. This has certainly been an eye-opener to me. I have only a few more weeks to spend in your wonderful country and I can truthfully say I do wish I had been here 20 years ago. The more I see of your ways and customs here the more sad I feel for your brother molders at home. We are behind, yes away behind, not only in our shop equipment and methods but also in our social and welfare study of the workmen which is—after all—in my opinion the secret of your success.

Well, Cherr-e-by American foundrymen and I am waving to you with "My Hat Off!"

SAND RAT

Who Mentioned Hard Luck?

TO THE EDITORS:

The best antidote for the poison of little faith and gloomy outlook is the story in Holy Writ known as the Book of Job. It describes the worst case of ill fortune ever bundled into shape for human burden. Job was prosperous, a man of fine character and in position to enjoy life and live long. In the course of Job's lifetime a convention was held, and like a disgruntled stockholder at the annual meeting, Satan was represented in person rather than risk his interests by proxy. Among other matters regularly brought before the meeting, the minutes record a discussion of the person of Job, his excellent character, reputation and all around good qualities. Then a motion was made to test him out.

First came bands of robbers, and highwaymen, who killed the servants and drove off the live stock. Whole flocks of sheep were burned up. And then a windstorm blew down the house where the sons and daughters were giving a dinner. A little later the protozoan parasite termed Helcosoma Tropicum, began an invasion and Job had a crop of boils, the most celebrated case in the history of medicine.

Here was a case of family destroyed, great wealth reduced to poverty, and a strong man infected near death with loathsome disease. Only his wife and three friends survived, and these were more active in bringing temptation than in sharing the burden. With all the hard luck, Job did not stampede, but gathering up a piece of broken pottery he went out into the back yard to scrape the boils and think

matters over. That was the best managed affair of clear seeing and straight thinking on record, and it ended with a decision founded on fact.

Job did not commit an act of bankruptcy, or in a wild panic plan a merger. There was no stock market to absorb the stock of depleted assets, and no chance for turning states evidence to shift responsibility. The capitalistic system was not assailed, no precedent laid down for socialist propaganda, Job did not turn Bolshevik, he did not even call the doctor.

At last the boils healed and the work of restoration came swiftly. Job's philosophy was simple as even today it is effective. He believed in the everlasting law of compensation, he never lost faith. Business, family and personal misfortune could not shake that brand of faith or warp the sound judgement which is ever found at the end of clear seeing and straight thinking. The good old patriarch Job, the subject of the first great drama in our literature; honest, sincere and true blue to the last history has claimed him for just that.

ROBERT C. HOPKINS
Alliance Brass & Bronze Co., Alliance, O.

Ohio Foundrymen Meet in Toledo

REGIONAL meetings, introduced last year by the Ohio Foundries Association, Inc., were continued this year with the first meeting Feb. 27 at the Toledo Yacht Club, Toledo, O., attended by about 70 members from various points in the north western section of the state. A proposal to adopt a monthly meeting night after the manner of many other foundrymen's associations was discussed and referred to a committee of three with Charles Carson, National Supply Co., as chairman to arrange details. April 15 was set as a tentative date for the first of these meetings.

At the formal meeting following a luncheon at 1:00 p. m. in the dining room of the Yacht club, addresses were presented by H. M. Lane, H. M. Lane Co., Detroit, on "Some Features of Present Day Foundry Practice"; by A. D. Lynch, director of personnel Ohio Brass Co., Mansfield, O., on "Safety Organization and Safety Program"; and by Pat Dwyer, engineering editor, THE FOUNDRY, Cleveland, on "Meeting Present Day Competition."

While admitting that mechanical equipment is essential to modern foundry practice and in fact largely is responsible for the high standard of excellence which now obtains in the industry, Mr. Lane deprecated the lack of vision shown in many instances. Foundries have been built and equipped to operate as single units under peak production conditions. No provision has been made for the inevitable day when business sinks to a low ebb and only a comparatively small trickle of orders passes over the wheels. An immense amount of machinery must be placed in motion to fill a small order. Other features touched upon included the human element in the foundry industry and the importance of mechanical equipment in handling and preparing the sand.

Adoption and enforcement of a safety program in any plant, according to A. D. Lynch, is based perhaps as fully on economic as it is on humanitarian motives. If foundrymen only could be convinced of this, he believes that the growth of the safety first movement would be accelerated to a remarkable degree. Conditions vary to a considerable extent in many foundries and no standardized program can be laid down that will serve as a guide or that will govern in every instance. Desire for safer conditions is the most important factor and this desire must be unanimous and enthusiastic from the general manager to the apprentice boys.

A. D. Lynch

By way of illustration Mr. Lynch described the inauguration of a safety first program at the plant of the Ohio Brass Co., and the methods that have been adopted since the inauguration to keep it running smoothly and to improve many of the features. One of the most important features is to change the personnel of the committees annually. In this way a larger number of men are brought into active contact with the functioning of the organization. Naturally their influence is disseminated to better advantage, than if one group remained in office over a more extended period.

Pat Dwyer directed attention to the fact that business peaks and depressions have manifested themselves many times. Eventually, perhaps, they may be abolished, but in the meantime they are as inevitable as the ocean tides. The business mariner must learn to accommodate himself to their rise and fall. The foundry business is not dead. It is not dying. The parent tree and most of the branches are flourishing as bravely as ever. The first law of economics is that to realize a profit and remain in business, the income must exceed the outgo, and only foundries observing this law can meet modern competition.

Foremanship Activities Listed in Bulletin

Purdue university, Lafayette, Ind., recently issued bulletin No. 25 reporting foremanship conferences held by the institution for the past 7 years. According to the bulletin, the foremanship activities during that period have reached about 400 Indiana companies including many foundries in 322 series of meetings attended by over 6000 foremen. The bulletin explains how the meetings are arranged and the policies followed by the university in that line of endeavor. A list of the products manufactured by companies served and another of the companies themselves together with the number attending the conference also is given. The report was written by G. F. Buxton, professor of industrial training, Purdue university, Lafayette, Ind.

Joins Equipment Firm

M. J. Kunert, for many years in charge of equipment, American Radiator Co. at its Kansas City, Mo., plant, has joined Black, Sivalls & Bryson Mfg. Co., Kansas City, Mo. The latter company has designed a new foundry flask and expects to enter the foundry equipment field. Other men from the American Radiator Co. now affiliated with Black, Sivalls & Bryson Mfg. Co., include H. C. King, formerly chief engineer, T. E. McWilliams, purchasing agent, and George Fowler, machine shop superintendent.

BILL

By Pat Dwyer

Comments on Large Cupola Practice

EVERY once in a while I come across an item in the old home paper touching on the activities of people I once knew intimately, but whose names in the intervening years have almost faded from memory. The sight of the name brings the person back again vividly although the picture in the paper—when the picture accompanies the item—r a r e l y bears any resemblance to the person I have in mind. In my mind's eye I see him or her as he or she appeared in the olden days. I have difficulty in adjusting my mental focus and accepting the face in the paper as the face of the youthful person I knew. My reason, of course, tells me that old Father Time has reversed his glass as often in the old home town as he has reversed it elsewhere, but so far as I am concerned he has been asleep on the job. Probably I have been asleep also. Each time I see one of the pictures of a former contemporary, I feel as old Rip Van Winkle must have felt when he opened his eyes and found that his beard reached almost to his stumpy little yellow toes.

Calling a mental roll of the boys of the old brigade I find that less than half a dozen still remain in the old home town as more or less active citizens. Several of the brightest and best were lifted out of the ranks while youth still was at the flood. The gentle breezes of summer have ruffled the grass above them with a caressing touch. The silent stars of winter have gazed down for many a year on the snow that lies lightly above their last resting place.

Others in the everlasting race for fame and fortune—a race in which luck usually is a more important factor that either speed or strength—have scattered far and wide. Witness Thomas Aquinas O'Brien, better known as Turnip, whose picture and brief story appeared in a recent issue of the old home paper.

The picture of a semibald, prosperous looking business man the owner of a winter home in San Francisco and owner of extensive gold properties in Alaska, bore little resemblance to good old Turnip who manfully tooted the B-flat bass in the Prospect Silver Cornet Band and between public appearances blew bottles in the glass factory.

Conditions in the glass industry have changed in recent years even to a greater extent than they have changed in the foundry. Bottles now are blown automatically with compressed air on a moving device which carries the molds past the glass tank and then dumps the bottles on a conveyor which deposits them in the *lehr*, the German name for annealing oven which still obtains in the glass trade.

Just a Little Warming Up Exercise

In the old days, a bottle blowing crew was made up of one man and two boys. The man dipped the end of a steel tube in a pot of molten glass and collected the proper amount to form a bottle. He placed the glass covered end of the tube in a two-part iron mold and applied his lips to the other end. By blowing through the tube, the molten glass was forced against the face of the mold to form the bottle. A high degree of skill was required to gage the exact amount of glass required. If the resulting bottle was slightly under or over weight it was thrown in the scrap box. One boy opened and closed two molds in turn and placed the finished bottle on a small scale. The second boy carried the perfect bottles away to the finishing department.

An idea of the speed at which the crew operated may be gained from the figures of a typical 8-hour shift. Oh, yes, the 8-hour day obtained in the glass industry in the early nineties. An average turn for an 8-hour shift was 2500 pint bottles or approximately 7 per minute.

As a matter of historical interest it may be pertinent to point out that these containers were manufactured at a period when the demon rum held high carnival in this fair land. Since the government took the situation firmly in hand several years ago and banished this scourge, the manufacture of pint bottles practically has ceased. The stuff now is handled in quarts. You would think a man keyed up to a speed of 7 bottles a minute would get all the blowing he wanted, that he naturally would turn to some form of recreation in his spare time where even breathing was reduced to a minimum, chess or checkers or something like that. Turnip's method of spending a nice, quiet evening varied according to the season. In summer he spent the balmy evening hours in the company of boon companions, on a vacant piece of land where they rested their poor tired bodies in the gentle exercise of throwing the hammer and putting the shot.

I have not seen any exhibitions of these sports in recent years. This may be due to one of two causes: 1—I no longer am interested in violent forms of exercise. To be perfectly frank I am not interested in any form of exercise and this in turn has exposed me—at times—to veiled accusations of laziness, but—oh, well, let that pass. Also let us pass on to the second cause of the passing of the manly sport of throwing the hammer. 2—With increased educational facilities and greater leisure, modern youth favors the sport of throwing the bull.

The hammer was a 14 or 16-pound ball attached to one end of a wooden handle about 4 feet in length. Each poor tired athlete in turn grasped the handle in both hands, whirled it around his head four or five times to gain momentum and then let it go in a graceful arc to land at an almost incredible distance.

The shot was a solid ball of about the same weight without any handle. The object of this game was to balance the ball in one hand, lift it above the shoulder two or three times to get the *heft* and then throw it as far as

possible without bursting their galls.

Either of these games imposed no more effort than that involved in shoveling about 10 tons of lump coal in a 2-hour period. Effeminate, you may say, but the hard working young lads of those days had to conserve their energies for the daily grind.

In the winter season, Turnip rested himself in a gymnasium where he put on the gloves with all comers, wrestled with those who were willing to risk dislocation of their arms and legs and practiced the most intricate evolutions on the parallel and horizontal bars.

Famous Last Words, "Hail and Farewell!"

On Thursday night he attended band practice in a big, bare room over Jenkin's butcher shop. He evinced only slight enthusiasm over the passages marked *p*. When his eagle eye rested upon an *f*, he took a firmer grasp on the instrument, distended his cheeks and big barrel chest and blew like a man. The occasional *ff* in front of a passage, raised him to the seventh heaven of musical ecstasy. The horn was converted into the roaring siren of a big ore boat booming down the Detroit river on a foggy night.

Doors and windows rattled in their frames. The floor vibrated and the only reason the ceiling did not come down was because it was wood and not plaster.

Eventually, probably if the program carried a sufficient number of fortissimo passages, he would have brought down the house—the term here is used in the Samsonian sense—but the story of the discovery of gold in the Klondike saved the building. It also finished Turnip's career as a bottle and horn blower. Incidentally it severed our acquaintanceship. The first intimation that he still was in the land of the living after a lapse of over 30 years, I had in the old home paper the other night.

With a few well chosen remarks the editor directed his reader's attention to the following item taken from an Alaskan paper of fairly recent date concerning the activities of a former old town boy whom, no doubt, many remembered.

The editor of the Alaskan paper betrayed a proprietary interest in good old Turnip and referred to him as one of the original settlers who came in with the first gold rush and then had remained to grow up with the country. A man of substance and a solid citizen who reflected credit on his adopted home.

I wondered idly, when I read that sentence, if the editor had a double meaning in mind when he penned it. In the olden days, Turnip certainly was a man of substance and a solid citizen, 200 pounds on the hoof, 6 feet high and one axe handle across the shoulders. I have no statistics on the interior arrangement, the boiler and engine room, but I am inclined to the opinion that they probably would pass inspection.

This opinion partly is based on early knowledge, but to a greater extent on the fact that Turnip mushed in over the Chilcoot pass with a bag of flour and a side of bacon, a frying pan, a coffee pot, a pick and shovel and an axe in a blanket roll strapped on his back. I don't know if he had a dog team, but if he had, the chances are that he dragged the dogs about as often as they dragged him. Very tender hearted, he was, with dogs and other dumb animals. He derived the keenest pleasure from battering an opponent to a stand still with a pair of boxing gloves, but every dog in the town wagged his tail and smiled when Turnip looked at him. The item in the paper induced a flood of old time memories and it was only natural that when Bill called last night that I should dwell on some of them. Elsewhere in these memoirs I have touched upon the fact that Bill and I served our time in the same shop at the ancient and honorable art and science of founding in metals. We also were associated intimately in the many activities which occupied our time with more or less benefit, outside of working hours. He was quite interested in the story about Turnip.

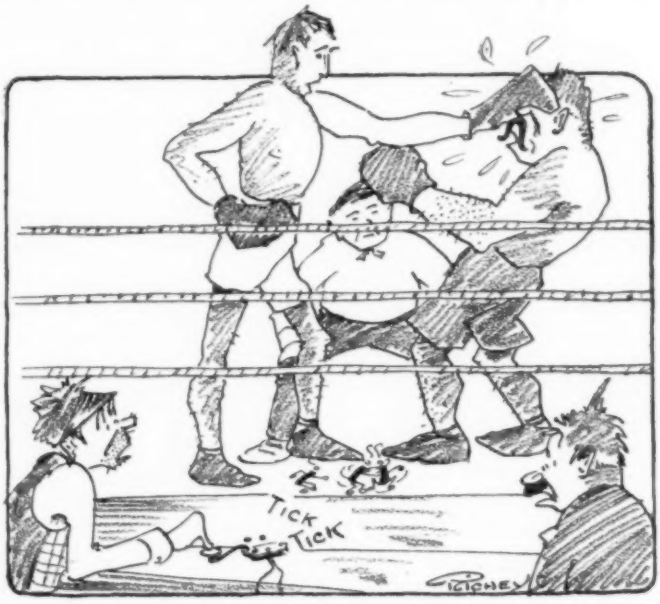
"Who would think," he said, "that the old walrus would turn out like that? I remember the excitement which followed the news of the Klondike gold strike. It was the sole topic of conversation all over the town. When Turnip told me he intended to go off on the grand adventure I would have given one of my good eyes to go with him.

"Unfortunately, in those days even as in the present, eyes, good or bad were not negotiable and my financial standing was at a particularly low ebb. I might have managed the railroad journey across the continent. It has been done by others and I have done some touring in later years, but I could see no way of negotiating the long hike from the terminus of the Canadian Pacific railroad into the far northern wilderness.

"The physical regiors of the journey held no more terror for me than they did for Turnip and thousands of others, but the prospect of fasting for three or four months, or, for living for the same period on a few handfulls of moss and pigeon berries, grubbed from under the snow, put the kibosh on the proposition so far as I was concerned.

"Just imagine," he continued regretfully, "if I had taken the chance I might now be rolling in wealth like old Turnip."

"Yes," I admitted, "and you might be lying in a shallow trench six feet by three like what's-his-name on the lone prair-ee, with a couple of tons of ice piled above your remains to prevent the wolves and other not overly sensitive animals from walking off with the fragments."



Old Songs Illustrated, "Then You'll Remember Me"

"Well," said Bill, "I'll tell you. The ways of old Lady Luck are beyond understanding. She taps one lad on the shoulder and almost immediately his fortune is made. She hits another lad a belt on the knob with a maul and sinks him for a count of ten. Each time he comes up for air he gets

another back handed swipe that lands him in the slough of despond.

"I don't think I ever told you of a chatty old lad I met on the train a few months ago. He is a telegraph operator at one of the offices here in town and was coming back from a vacation. At one time or another he has worked in places all over the country and we found many points of interest in exchanging reminiscences.

"One of his earliest assignments was covering the Sullivan-Corbett fight in New Orleans. He supplied me with many interesting and intimate details of that memorable event. Then he drifted into a discussion of the part luck plays in the career of every man and offered a resume of his own as a case in point.

"Several years ago he decided the telegraph business was a washout. He opened an undertaking establishment, but people persistently refused to die in anything like satisfactory numbers. Relatives of the few cases he handled were so slow in paying that he could not make ends meet.

"Finally he was glad to dispose of the business for a song to his brother-in-law. A month afterward an epidemic of flu hit the city and the brother-in-law cleaned up enough to retire on. Tough, eh?

"At one time," Bill continued, "foundrymen believed that melting iron in a cupola was all a matter of luck, some days, good, some days, bad, but never certain. The element of luck is present to some extent as it is present wherever the human factor is engaged, but the operation of a cupola now is fairly well standardized. However, controversial points still turn up occasionally.

"I had an inquiry recently from a man who operates two 84-inch diameter cupolas on alternate days to melt 180 tons of iron with 22 tons of coke in 8 hours. The bottom line of the tuyeres is 18 inches above the sand bed and the charge of coke on the bed is 5600 pounds. This is followed by alternate charges of iron and coke in the proportion of 8000 pounds of iron to 800 pounds of coke. He places a double charge of coke, 1600 pounds, on the tenth charges of iron to renew the bed and maintain a temperature of approximately 2550 degrees Fahr., at the spout.

"He uses beehive coke and the iron charge is made up of pig, 55 per cent; foreign scrap 25 per cent; return scrap 20 per cent. Under the belief that the coke ratio was too high he raised the iron charge to 9000 pounds, but found that he had to add an extra coke charge with every fifth charge to maintain the required temperature.

"The manufacturer claims a melting speed of 24 to 27 tons per hour for each of the cupolas, but the best he can get is between 22 and 23 tons. The lining is reduced to 74 inches about 36 inches above the bottom but gradually expands again to the full 84 inches. The 2-inch slag hole is located immediately below the level of the tuyeres, but it cuts away to such an extent that he has to shut off the blast occasionally to repair it. He uses a standard fire brick lining in the cupola, but it seems to require an excessive amount of patching daily and a complete relining every 2 or 3 months. He wondered if the daubing is responsible. He uses a thick local clay mixed with ganister half and half which develops large cracks in drying. He has tried using a larger proportion of ganister, but the men claim it will not stick to the bricks. He said he would be interested in any comment I might offer.

"In replying to this inquiry I took up the various points in the order in which they were presented. I pointed out that the coke ratio of 900 pounds of coke to 8000 pounds of iron is not excessive since apparently he needed exceedingly hot iron to pour his castings. In the automotive field the proportion of coke to iron is approximately 1 to 6. Instead of placing a double charge of coke on the tenth iron charge I suggested he should place an extra 100 pounds of coke on each charge and thus maintain more even melting conditions and insure a uniform drop in the column of material in the cupola.

"The decreased diameter in the cupola above the tuyeres accounts for the reduced melting speed. His melting area really is only 74 inches in diameter plus the thickness of the lining that burns away during the progress of the heat.

"Any cupola in blast continuously for 8 or 9 hours is bound to burn away the lining to a considerable extent and entail extensive patching after every heat. Without an actual examination I said I was handicapped in expressing an opinion regarding the daubing material, but as a general rule, sticky local clay does not make the best daubing. The fact that the daubing material presents large cracks is evidence that it is too *tight*, apart from whatever refractory qualities it may possess. It should be mixed with a larger proportion of ganister. Where it becomes necessary to repair the lining to a greater depth than 1-inch, pieces of split brick should be employed, bedded in a thin coating of daubing material. Before blaming the material for the manner in which the slag hole becomes enlarged I suggested that he should check up on the slag and see if there is not some iron going through with the slag."

R. R. Wason recently was elected president Manning, Maxwell & Moore, Inc., New York. He succeeded C. A. Moore who had been the president of that company since April, 1927. Mr. Moore retains his contact with the company as chairman of the board of directors.

Research Assistantships Are Available

University of Illinois, Urbana, Ill., maintains 14 research graduate assistantships, including two under the patronage of the Illinois Gas association, in its engineering experiment station. Those assistantships, for each of which there is an annual stipend of $600 and freedom from all fees except matriculation and diploma fees, are open to graduates of approved American and foreign universities and technical schools who are prepared to undertake graduate study in engineering, physics or applied chemistry. An appointment as research graduate assistant must be accepted for 2 years consecutively, consisting of 10 months each. At the expiration of that time, if all requirements have been met, the degree of master of science will be conferred. Half of the time of a graduate assistant is required in connection with the work of the department to which he is assigned and the remainder is devoted to graduate study. Applications for such positions must be received by the director of the experiment station not later than April 1, appointments taking effect in September. For further information, address the Director, Engineering Experiment Station, University of Illinois, Urbana, Ill.

Foundry Equipment To Be Standardized

American Standards association, 29 West Thirty-ninth street, New York, has undertaken the standardization of foundry equipment. The project will be under the technical direction of the American Foundrymen's association and the American Society of Mechanical Engineers, assisted by a committee representing manufacturers of foundry equipment, government metallurgical specialists, and important branches of the foundry industry.

The work will be carried out under the administrative procedure of the A. S. A. and will lead ultimately to the preparation of a group of authoritative standards for various types of equipment used in the different branches of the foundry industry. Several years ago the various branches of the foundry industry cooperated with the A. S. A. to prepare a safety code for foundry workers.

Quad-City Foundrymen Will Meet

The March meeting of the Quad-City Foundrymen's association will be held March 16 at the John Deere Athletic club, East Moline, Ill. E. P. Greist, general manager, Chicago Railway Equipment Co., Chicago, will deliver an address on "New Developments in the Malleable Iron Industry."

Questions & Answers on FOUNDRY PRACTICE

GRAY IRON

Aluminum Is Added

One of our customers wants some fine-grained cast iron rolls for transfer printing, and he states that he has seen such rolls made with a small addition of aluminum to the iron.

Aluminum is used to a considerable extent to deoxidize steel, and it has been applied as a deoxidizing agent to quiet heats of low silicon, white iron made in the cupola from all steel scrap. Aluminum also acts as a graphitizing agent in gray iron, and according to Jeffries and Edwards, it is approximately equal to silicon in its effect, and may be added without increasing the total carbon content of the iron. Everest states that more aluminum is required than silicon and mentions that in an iron containing no silicon the maximum graphite precipitation (61 per cent) occurs with 4 per cent aluminum. That figure may be compared with a graphite precipitation of 70 per cent with 3 per cent silicon. It also is claimed that aluminum precipitates the graphite more finely divided than does silicon.

While it may be that the aluminum was added to obtain the graphite more finely divided than would be the case with increased silicon, we believe that it was added for its deoxidizing effect. If your metal is melted properly, and hot, you probably do not need a deoxidizer, and therefore could notice no startling effect when you added aluminum. However, if your melting practice was bad, it is possible that the aluminum additions would improve the casting quality of the iron.

To obtain information on the effect of aluminum on iron for your purpose, we suggest that you conduct some experimental work. Reduce the silicon content of your present mixture by additions of steel scrap until the rolls are too hard for the intended purpose. Then add varying amounts of aluminum (pure commercial and not No. 12 alloy) beginning say at 0.25 per cent, and increasing the quantity until the roll surface is of the desired softness. The aluminum should not be thrown on the surface, but should be plunged under it. However, see that the aluminum is warmed beforehand.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall
Cast Steel

H. A. Schwartz
Malleable Cast Iron

J. W. Bolton
Gray Cast Iron

All questions must be addressed to the Editor, The Foundry, Penton Building, Cleveland.

Q & A

Wants Low Sulphur Iron

Can cupola iron be produced commercially with a maximum sulphur content of 0.05 per cent?

We do not believe that it is possible to produce gray iron by the cupola process commercially with as little as 0.05 per cent sulphur, as practically all of the possible raw materials contain at least that quantity of sulphur to begin with, except possibly charcoal pig iron which sometimes is claimed to contain only traces of sulphur. Since the raw materials contain 0.05 per cent sulphur, and a pickup of from 0.02 to 0.04 per cent sulphur may be expected from the coke, you can see that the chances of producing iron with 0.05 per cent sulphur maximum are remote.

However, it is claimed that an appreciable sulphur reduction may be obtained by using a soda ash flux. Examples are given in which the sulphur has been reduced from 0.078 per cent to 0.049 per cent, and from 0.069 per cent to 0.047 per cent by treating the metal in a mixing ladle or forehearth with soda ash flux.

Low sulphurs such as 0.07 to 0.08 per cent may be obtained by careful attention to raw materials used, and the melting operation. Low sulphur pig irons and preferably steel scrap which usually does not contain over 0.05 per cent sulphur, coke with sulphur not over 0.70 per cent will assist in obtaining low sulphur in the resulting metal.

Q & A

Changes Are Suggested

We have a small quantity of cores to dry. We have a small boiler at the plant and I am wondering if it would be possible to cut a hole in the side of the firebox and insert a swinging shelf into the opening for drying the cores. The shelf would be arranged so that the opening would be closed when the shelf was entirely within or without the furnace. We also have about 150 tons of reclaimed iron from the slag dump of which we are melting 20 per cent in the charges. The heavy sections come out good, but the light sections fail to run. The metal is hot when it comes out, but gets cold quickly. Is there any way to keep it hot that would not add greatly to the expense of melting?

While the idea you propose may work, it is believed that the cores would be burned most of the time unless constant attention was given. It will be much better to devise some other means for drying. You might purchase a small coredrying oven from advertisers in The Foundry. You could build a small oven from sheet steel or construct it

with bricks in a short time. In some old foundries, the cores were dried on the top of the drum-type stove used for heating. Perhaps you can get hold of an old cook-stove with an oven, and use it, or an old sheet metal oven such as used on top of a gas plate. Set the latter up on a few bricks so that you can build a small fire under the oven.

From your description of the trouble you are having from the reclaimed iron, we surmise that it has been burned or oxidized, or that those reactions are taking place in your cupola. If the first condition is true, you will get better castings by eliminating the use of such material from your charges. You can determine whether the reclaimed iron is at fault by leaving it out of the charges for several days, and watching the effect upon the quality of the castings. If it is necessary to use the iron in your charges, cut the amount used to 5 or 10 per cent. If no difference is observed while the reclaimed iron is out of the charges, your cupola conditions should be checked to see that you have the correct bed, blast, and coke to iron ratio. The bed should extend about 30 inches above the tuyeres. The coke to iron ratio may vary from 8 to 10 to 1, and the air may be figured on the basis of 136 cubic feet per pound of coke.

GENERAL

Chills Stick to Casting

We space the chills on the ways of our lathe beds ¼-inch apart to allow for expansion and contraction, but we find that they do not break away from the casting as readily as they should. At present we are experimenting with a silica wash over which we sprinkle fine sharp sand while the wash is liquid. This is then dried with a torch and the excess sand is blown off. We have found this method reasonably effective, but would like to know if there is not some formula for mixing a wash that will serve the purpose?

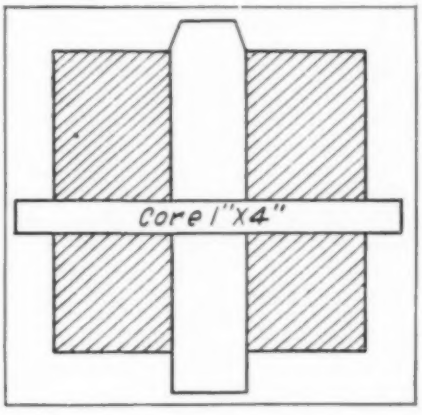
We are inclined to the opinion that the thickness of the chills and not the character of the wash is responsible for your trouble. Heavy chills will absorb and radiate the heat from the molten iron to such an extent that the face will not become sufficiently heated to stick to the casting. This is demonstrated every day in the casting of chilled rolls and crusher plates. Chills for these castings either are left bare or are covered with a thin coating of oil or of oil and plumbago. In some instances they are washed while hot with thin blackwash. You do not state whether the chills are rammed up with the pattern, or placed in the mold afterward. If the molds are skin dried, the chills are blacked at the same time the remainder of the mold is blackwashed. Chill face and mold face are dried simultaneously. Foundry supply houses can furnish you with a special silica wash designed primarily for coating steel cores and other inserts in iron castings.

Q & A

Should Adjust Mixture

We are having considerable trouble with a core 1 x 4 inches which extends through a 4000-pound casting in which the metal thickness around the core is 6 inches. The core is made from Lake Michigan sand bonded with a high grade core oil 1 to 45. We are forwarding for your inspection part of the combined core sand and iron as it was removed from the casting.

The sample of core submitted shows no sign of iron penetration. The density to which you refer and which prevents you from removing the core readily from the casting, is due to a combination of causes including temperature, pressure, sand and vents. In



The Comparatively Thin Core Is Surrounded by a Thick Metal Section

this instance the entire core is raised to the temperature of the molten iron with which it is surrounded. Naturally this fuses any fusible elements in the core. Then the casting begins to contract and in so doing exerts a tremendous pressure on the partly fused core. The binder instead of being consumed is carbonized and remains to unite with the sand grains in an impentrable mass. The remedy for all this is to reduce the core binder to the lowest amount at which the core can be handled safely.

Several grades of Lake Michigan sand are available for foundry purposes. For this core a grade should be selected containing practically no natural bond. The ideal sand for the purpose is the silica sand used in steel foundries. The core should be dried almost to the burning point and should be covered with a thick coating of blackwash or silica wash. One of the most important features is to provide liberal vent openings and thus promote complete and open combustion of the binding material. This may be accomplished by spacing three ⅜-inch rods an equal distance apart in the corebox and with the ends projecting through suitable openings in the ends of the corebox. After the sand has been rammed and slicked down the rods are removed. When this core is surrounded by metal the gas will escape readily through these large vents and when the pressure is exerted later the cavities will enable the core to yield.

Q & A

Bottle Mold Is Open

We are making bottle molds for a glass factory and our customer complains that the metal in the neck is porous. We shall appreciate any advice on how to correct this condition.

Lacking any sketch or further information, we assume that the mold is made in the usual manner, that is all the mold is in the cope with the exception of the flat face which is on, or a little below, the parting line in the drag. The half impression for the bottle is formed with an iron core which is placed in the drag. The porous metal in the neck may be due to the composition of the metal, to the unequal sectional thickness of the casting, to a low pouring head, to lack of a feeding head, or to a possible combination of any two or more of these factors. By checking each one in turn you can discover the cause of the trouble and take the proper steps to eliminate it. One of the prime essentials of these castings is that the machined face shall be as hard as possible inside machining limits. Part of this hardness is secured by using an iron core and the remainder by pouring the casting from a mixture comparatively low in silicon content. The exact composition depends on the size and thickness of the mold.

Thus, for a mold in which the metal thickness is 2 inches, a typical analysis would show: Silicon 1.75 per cent, sulphur 0.10 per cent, manganese 0.65 per cent and phosphorus under 0.40 per cent. For thinner castings the silicon may run up to 2.00 per cent with little if any variation in the other elements. The mixture usually contains from 15 to 25 per cent steel scrap. Where the outside contour of the casting does not follow that of the inside, at least approximately, a segregated or *drawn* area will develop at the junction of the thick and the thin section, in this instance at the part forming the junction of the neck with the body of the bottle. The logical remedy is to change the design of the pattern, but if this is not permissible, a row of large-head nails in the mold will impart an internal chill to the iron at this point. The nails must be clean and dry, otherwise they will cause a commotion in the molten iron and a resulting collection of blowholes. If the porosity is due to shrinkage, it may be cured by raising the pouring head—in ex-

treme instances 6 or 8 inches—and by pouring the metal slowly after the iron core on the bottom face of the mold has been covered. Under certain conditions and with some iron mixtures, it may be necessary to place a feeding head on top of the casting and churn the metal for a few minutes.

Q & A

Excess Air Indicated

We have noticed in many foundries that once the slag hole is opened it remains open during the length of the blow. We have been in the habit of tapping the slag hole at fixed periods, and when we have tried to allow the slag to trickle out, it usually makes a large hole, and blows out in a dangerous manner. Can you tell us just why that happens and how we can arrange our slag hole so that the slag will run out without special attention?

We also find that we have to keep poking the tuyere holes and we wondered if there is anything wrong with our lining that causes a constant blackening around the tuyeres. Is it important that they always should be bright? We also find that we have a heavy wear on the lining above the tuyeres. Can you tell us what is wrong there? We are using 6 tuyeres equally spaced, and are getting splendid results in quantity melted. The blast pressure is about 11 ounces.

Can you tell us if it is popular practice to use siphon taphole bricks in cupolas in America? We have seen illustrations of those brick, but never have seen one in operation. It would seem as though the syphon brick would give a good mixture of metal in our particular work where we are running the metal out continuously.

The first thought that comes to mind after reading your inquiry, is that you are using an excess of air, since a blown out slag hole, scored lining, blackened tuyeres, and "splendid results in quantity melted" all point that way. If the slag hole has been put in properly, the slag is of the proper composition, and the cupola operated correctly, there will be no trouble. The opening for the slag hole need not be over 1½-inch diameter; a larger opening is undesirable. The hole should slope down from inside to outside. When the slag is first tapped, observation should be made through the tuyere openings to see that the slag is above the opening. Then the slag will run out after the bod is removed, and clear the hole. If the hole is opened before the slag is high enough, it will fill the hole slowly and freeze therein. Consequently, the hole has to be reopened which is a messy job, and the hole is enlarged to such an extent that the slag flies all over. Since you allow the iron to run continuously from the tap hole, and presumably the cupola melts at the same rate as the metal is withdrawn, you can maintain a definite slag level in the cupola at all times, and that is the practice followed where the slag flows continuously from the slag hole.

Enough limestone should be used to give a fairly basic slag, and such a slag will run freely. When examined, it will be found to be quite brittle and fragile when cold. The powdered slag is light gray in color. Usually about 3 per cent of the weight of the iron charge is the amount of limestone used; that is to say with a 1000-pound charge of iron, 30 pounds of limestone is employed. Blackening of the tuyeres may indicate excess air (by volume), too high a velocity of the air (caused by restricted tuyere area), or that the patching material is not refractory enough. If the latter is the case, the patching material fuses and slides down over the tuyeres. These conditions also are responsible for the heavy lining wear. We cannot say which is the more responsible, but it is suggested that you place pressure and volume gages on your cupola. Blackening of the tuyeres by itself does not necessarily indicate anything serious, but in connection with the other points mentioned, it appears that you are melting too fast for the best results.

As far as we know, the siphon tap hole brick is not used at all in this country. Hurst in his book "Melting Iron in the Cupola" describes such a brick, and states that it was developed by Ronceray. Some foundries use a slagging spout which employs a principle similar to the siphon brick. The channel of the spout is arranged in such a manner that a pool of metal with slag on top is held back by a brick. The clean metal flows from under the brick while the slag overflows at one place in the space between the brick and the cupola.

Q & A

Core Causes Trouble

We use quantities of gray iron castings with cored chambers that later are subjected to steam pressure. We have had considerable difficulty in removing all of the core sand from the castings. Is there any satisfactory washing or cleaning process that will accomplish that service?

One of the first things to investigate is the practice used in making the cores. If just sufficient binder is used to make the cores strong enough to be handled, and the cores are baked properly, you should have no trouble in removing the cores. A type of casting similar to yours is a cast iron radiator section used for heating. That is subjected to steam or water pressure and must be free from sand. No difficulty is encountered in removing the sand as it flows out like water when rapped a few times. Cores for radiators are made with a linseed oil base binder which may be purchased ready mixed from core oil manufacturers advertising in THE FOUNDRY. The ratio of sand to oil is about 50 or 60 to 1. No wires are used, and the cores are strong enough to stand considerable handling.

There is a possibility that through carelessness, water may be allowed to enter the cored sections, and wet sand is difficult to remove through small openings. In such cases the casting will have to be heated until the sand becomes dry enough to pour out of the openings.

If you want to soak the sand out, several solutions are employed. Those are mixtures of acid and water. The preferable acid is hydrofluoric which attacks the sand, but not the iron. Try a mixture of 1 part of 30 per cent hydrofluoric acid to 15 parts of water. Soak the castings until the sand is removed, and then wash well in water. Hydrofluoric acid solutions are caustic and may cause severe skin burns. Sulphuric acid and hydrochloric (muriatic) acid solutions also are used. Those acids attack the iron rather than the sand so that the action must be watched carefully to see that the casting is not attacked too severely. Sulphuric acid is used in the ratio of 1 part acid to 10 parts of water. Hydrochloric acid solutions contain about 1 part acid to 1 of water.

STEEL

Carbon Is Important

Can you give me any information on what factors increase or decrease the physical properties of electric steel? For example, what increases the elongation, reduction of area, yield point, tensile strength, etc.?

The physical properties of electric steel are affected by exactly the same factors as the properties of any other steel. In all simple carbon steels the tensile strength and yield point are at a minmum, and the elongation, reduction of area, bend, and shock toughness are highest when the carbon is low. As the carbon is increased, the tensile strength and yield point rise, and the elongation, reduction of area, bend, etc., decrease. At 0.80 to 0.90 per cent carbon the strength and yield point reach a maximum, but further increase of carbon still further decreases the elongation, reduction of area, and bend.

The addition of nickel, and certain other alloys to steel, increases the tensile strength and yield point with far less sacrifice of elongation, reduction of area, etc., than a similar increase of strength due to carbon only produces. In addition, suitable heat treatments of certain steels will increase the tensile strength and yield point, with little or no decrease in the elongation, reduction of area, etc. Specific data on that subject is given in books on heat treatment.

Problems in Nonferrous Founding

By Charles Vickers

Metal Is Not Burnt

We are making castings for high speed bearings which are about 6 inches long and 5 inches in diameter with a 3½-inch diameter core through the center. The metal used is the 80-10-10 *alloy which is melted under charcoal in a forced draft, tilting type furnace. Six ounces of phosphor-copper is added just before the white metals, and the castings are poured at* 1900 *degrees Fahr. After the castings are machined, small black specks appear. The customer claims these result from burnt metal while we claim they do not. We are sending a sample of the metal for inspection.*

Since the customer undoubtedly is unfamiliar with nonferrous metals and alloys, the condition described will appear to him as though it is the result of burning or charring some constituent of the metal. However, do not be misled by the cry of burnt metal, and try to avoid burning the metal as the difficulty will grow worse instead of bettter.

Examination of the sample indicates that the metal instead of being burnt or oxidized probably has been melted under reducing conditions. Therefore, reduce the phosphor-copper addition to 4 ounces, and just before pouring scatter a tablespoonful of litharge or red lead over the surface of the metal. Puddle the material in, and allow it to stand a few minutes before pouring.

Q & A

Brass Contains Iron

We would like to know how crucibles are made and if you can give us a good formula of graphite and fireclay used in making crucibles for melting brass and gray iron. We have had some trouble in casting brass when we used old scrap brass as material. The castings were hard to machine, and the tool was dulled and had to be sharpened often. Can you advise the cause of this? We also tried brass of good quality such as railroad journel bearings and the result was the same.

The manufacture of graphite crucibles is a highly specialized industry. There are so many difficult problems to master before any sort of success can be attained in that art, that few, if any foundrymen ever attempt to make their own crucibles, but leave the business strictly in the hands of manufacturers who specialize in this branch of the pottery trade. In a general way the composition of graphite crucibles may be said to consist of 35 per cent plastic clay; 45 per cent graphite, and 20 per cent ground old pots.

The reason that the castings made from scrap brass were too hard to machine was because they contained iron as little hard specks and when the tools struck these hard points the edges were broken off. If you can obtain such objects as old faucets and valves and remove all iron parts from them before melting, the resulting castings will machine without difficulty. Old car journal bearings are unreliable material. Even if the metal was high grade it would be only suitable for bearings.

Q & A

Alloy Has Hard Spots

We have trouble making small plate castings, ¼ to ⅜-inch thick, which weigh about 1¾ pounds each and are machined on both sides. The alloy has 85 *per cent copper,* 5 *per cent tin,* 5 *per cent lead, and* 5 *per cent zinc. The castings appear sound in the rough, but machining reveals small hard specks on the top side which take the edges off the tools. Electrolytic copper and virgin metals are melted in a coke-fired, tilting-type furnace. The charge is composed of one-third to one-half new metal and the remainder sprue and our own return scrap. A* 150*-pound pot of metal is melted in* 45 *minutes. Zinc is added* 5 *minutes before pouring and the lead and tin is added just before pouring. Charcoal is charged with the metal. We understand that the inclusions are tin oxide, and that phosphorus cannot reduce that substance once it is formed.*

The hard spots are not caused by tin oxide. While tin oxide in small quantities may be present in oxidized, high tin-copper alloys, there is no reason to believe that such is the case with the 85-5-5-5 alloy. Your alloy may be improved by increasing one of the white metals at the expense of the others. For example if improved machinability is desired, increase the lead to 6 per cent at the expense of the tin. If a better casting quality is wanted increase the zinc 1 per cent at the expense of the tin. Either of the changes may eliminate the hard spots, but if they still persist, it may be that they are caused by iron or by phosphorus.

Even though you use new metals, check over your methods to see that iron does not enter the metal. Pure iron in solution may produce black or dark colored surfaces, but furnace atmosphere high in sulphur dioxide may form iron sulphide which results in hard spots on the cope near the gate. Hard spots of phosphide may be caused by an excess of phosphor-copper. The maximum quantity of 15 per cent phosphor-copper to be used is 1½ ounces per 100 pounds of metal. A flux such as a thin coating of glass during melting also may eliminate the trouble by protecting the metal against oxidation.

Q & A

Ingot Metal Preferred

We are making bushings that are used as motor bearings for cotton mills but experience trouble due to the fact that the brass is too hard. We melt in crucibles holding about 100 *pounds of brass, and the mixture consists of* 50 *per cent ingot brass, and* 50 *per cent scrap brass. Can you suggest a more suitable mixture?*

Perhaps the addition of a little lead would help the situation. Change the mixture to 50 per cent ingot; 45 per cent scrap metal, and 5 per cent lead. The lead will be a great improvement from the bearing point of view. While 5 per cent of lead scarcely would be enough in itself, the ingot and the scrap metal will undoubtedly carry a percentage of lead, which with the added 5 per cent will be enough. If, by *hardness* it is meant to convey the type of hardness associated with a steel file, the lead addition will be the solution of the difficulty. The 5 per

cent suggested can be exceeded, and the addition increased until the desired ease of cutting is obtained, provided that such addition is *held* by the brass and does not spot out, or *drop* as shown by the surface of the castings. Some machinists however, associate hardness, with toughness. For example pure copper would be called hard, because it is difficult to cut. For that sort of hardness, add about 3 per cent tin, and 5 per cent lead.

It would be far better though, to work toward a given formula in all mixing of metals to make brass, but that does not permit the use of scrap metals. There is no way in which the composition of a pile of scrap metal can be known without sorting, melting and ingoting, and then analyzing, so in the end, such scrap would cost more than all ingot metal. If it is desirable to use an alloy of copper 76 per cent; tin 7 per cent; lead 15 per cent, that alloy can be bought in the ingot form and will prove a suitable alloy for the bearings mentioned. Should the ingot carry a small percentage of zinc it will do no harm to its bearing qualities, and the alloy will cast more soundly.

Institute Gives Test Results

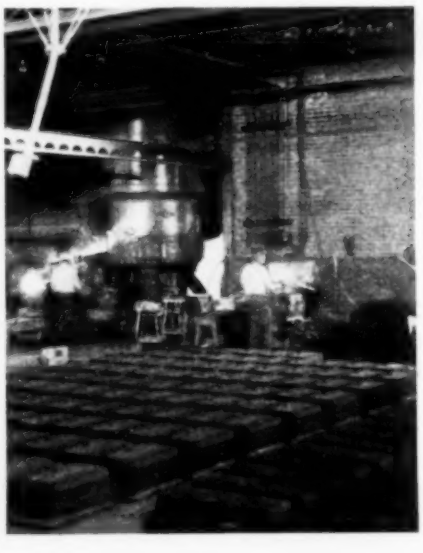
GRAY Iron institute, Terminal Tower building, Cleveland, recently issued technical bulletin No. 2 giving information on results obtained from test bars submitted by 48 member foundries. Approximately 800 test bars were submitted with information giving the type castings, weight of the heaviest and lightest castings and the average weight of castings made from the mixture, maximum and minimum sections, pig irons used and their analyses, mixture used in the iron, alloys used and the place in the heat in which the test bars were obtained.

Results obtained from the tests differ considerably from the results obtained in the maker's plant in a number of instances. This was thought to be due to the wide variation in length, diameter and form of bars submitted. Apparently no concentrated effort had been made to produce bars with the dimensions of the standard arbitration bar. Of the bars submitted, 2 per cent were 12 inches long, 10 per cent were 14 inches long and 88 per cent were 21 inches long, 4 per cent were under size, 10 per cent were over size and 86 per cent were within 0.05-inch of the correct diameter, 1.20 inches. Surface condition varied considerably.

Upon examination of the results obtained, it was found that about 40 classes of castings would include most of the products. Those data obtained have been included in four test sheets which give such information as mixture used; probable calculated analysis except in those cases where actual analysis was made; transverse strength in pounds on 18-inch centers; deflection; modulus of rupture; color, grain size and luster of fracture; tensile strength in pounds per square inch; brinell hardness; range of sections in the castings made in the particular plant; and classes of castings. From those data, it was found that metal for gears generally is made from mixes containing 10 to 40 per cent steel and has a transverse strength of 2200 pounds and upward with high deflection. Metal for hard wearing castings takes large proportions of scrap, either steel or low silicon iron. Transverse strength was approximately 2000 pounds with moderate deflection.

Metal for general machinery showed the results of efforts to keep the metal sound over wide variations of cross sections. Large quantities of high grade scrap, steel and alloys are used. Physical properties showed no outstanding feature but the practice of lowering the silicon content as the sections become larger was observed. High test gray iron both with and without alloys is used for machine tool parts and tensile strengths of 35,000 to 40,000 pounds per square inch were not unusual. Soundness in flywheels is insured with the use of large proportions of steel and a low silicon content. Brinell hardnesses of approximately 200 was common. Hydraulic presses and general heavy duty castings showed similar properties. Stove plate and furnace part metal required good surface and stressed chemical composition. Silicon was around 2.50 per cent and phosphorus about 0.40 per cent. Where some strength was necessary, as in boiler castings, a transverse strength of 1800 to 2000 pounds was not uncommon.

Grate bars and stoker parts showed a slightly lower silicon than other stove and furnace parts. Ferromanganese, ferrosilicon and nickel were used in that class of work. Metal for automobile castings contained from 45 to 60 per cent scrap and up to 17 per cent steel rails in the mixtures. Silicon was kept above 2 per cent to secure machinability. That class of castings had a fine, dark grain structure. No predominating characteristic was found in metal for cylinders. Valve metal showed a transverse strength of over 2000 pounds and a brinell hardness of 190 or over. Steel and ferroalloys were used in the mixtures and the fracture has a light colored, fine, gray, sparkling appearance. Iron for pipe and flange fittings was made from a higher proportion of scrap than valve metal and brinell hardness numbers of 207 and higher prevailed. Pressure castings showed a fine grain structure which was darker than the ordinary run of pipe and valves. No uniformity of metal mixtures existed for municipal castings. Brinell numbers of well over 200 were noted with low deflection. That was not accompanied by uniformity in transverse strength. Wear and resistance to weather conditions appeared to be the outstanding requirements for that class of castings.



Iron for ornamental work showed a uniformly high silicon content of 2.50 per cent and up with phosphorus around 0.60 per cent. A fluid iron and a good surface are the most desired features of that type of metal but a tough iron of over 2000 pounds transverse strength and over 25,000 pounds per square inch tensile strength also was noted. Mixtures uniformly contained 50 per cent or more pig iron. Electric motors, meters and light hardware fall in the class of the higher silicon and phosphorus irons. No uniformity in strength was noted but the deflection remained consistently over 0.25-inch. Frames and fittings, both for static loads and moving parts, were largely in the 2200-pound transverse strength range with deflections of 0.25 to 0.30 inches. Metal for locomotives and marine engine parts showed a transverse strength which varied between 2000 and 2600 pounds. It was indicated that the higher figure would not be hard to reach from the results obtained by the use of steel and alloys.

What Others Are Thinking

Abstracts Selected from European Foundry Literature

Study Mold Cooling Speed

Permanent Molds and the Influence of Cooling Speed on Gray Iron (Ueber Dauerformen und den Einfluss der Abkuehlungsgeschwindigkeit bei Grauguss), by E. Kottgen, *Die Giesserei*, Duesseldorf, Germany, Oct. 31 and Nov. 7, 1930.

In the production of castings by the permanent mold process, it is necessary to control conditions so that machinable castings are made if the process is to be successful. To ascertain the various factors that affect the resulting castings, the author carried on investigational work particularly upon the effect of cooling speed. His work includes many curves showing the effect of mold wall thickness, mold preheating, pouring temperature, metal melting temperature, heat conductivity of the mold, etc. His investigations show that cooling speed of the castings produced in permanent molds is dependent upon the section thickness of the casting and the mold, preheating of the mold, heat conductivity of the mold, pouring temperature, etc. If a pouring temperature lower than that at which the metal was melted is used, the brinell hardness increases while if the same temperature is employed, the brinell hardness decreases. Transition points obtained with an oscillograph indicate that graphite, especially eutectic graphite is separated directly from the melt. Investigation of superheating the melt shows that it is without influence on the structure and origin of eutectic graphite, if soluble gases are artifically retained in the melt, or the alloys are hypereutectic.

Cupola Malleable Produced

Cupola Malleable Cast Iron, by H. H. Shepherd, *Foundry Trade Journal*, London, Jan. 29, Feb. 5 and Feb. 12, 1931.

Both black-heart and white-heart types of malleable iron are produced both in the cupola and in the air furnace. Although cupola malleable of the black-heart variety does not have physical properties equal to air furnace, iron, it is applicable to many types of castings.

Patterns used in foundries producing black-heart iron by the cupola process, usually are mounted on plates. Runner size and shape vary according to type and size of castings but rectangular section runners are favored. Feeders and runners on malleable castings usually are larger than those employed on gray iron but experience has shown that it often is not necessary. Core mixtures used are of two classes, one having practically no green bond and the other being high in that quality. Oils are used as bonding agents. Two kinds of core sand are used, dry sea and washed pit sands, the author preferring the latter. Such sands must be low in silt, dirt and clay bond because such factors reduce permeability and increase the consumption of core oils. A maximum of 3 per cent of silt or weak bond is permissible in the plant in which the author is employed.

A more open molding sand is necessary for malleable castings than for gray iron and it must be tested for bond strength, moisture, and coal dust content. Moisture usually is kept between 4 and 5 per cent and coal dust content for small castings may be approximately 7 per cent. Daily tests are required. Apparatus differing slightly from the standard A. F. A. apparatus is used.

Metal composition in the production of cupola malleable iron must be controlled carefully. Total carbon must be as low as possible to produce a fluid iron but preferably not below 3 per cent. Silicon content is about 0.74 per cent. It is necessary to control the carbon-silicon ratio within an exceedingly fine limit. Sulphur is higher than in air furnace iron and should be kept below 0.2 per cent. Manganese is used to balance the sulphur and as slight an excess as possible should be maintained as manganese retards the second stage of graphitization. Phosphorus should be kept below 0.2 per cent. Any chromium should be avoided. Structures of air-furnace and cupola malleable iron differ, the former containing approximately 75 per cent pearlite and 25 per cent free cementite and the latter 60 per cent pearlite and 40 per cent free cementite in the hard condition.

While it is recognized generally that malleable should be melted at as high a temperature as possible, it does not follow that it should be poured as hot as possible. There are several objections to that practice two of which are the higher the pouring temperature the greater the shrinkage and in many type castings the greater the tendency toward cracking and the higher the pouring temperature the larger the cementite areas.

Successful production of cupola malleable depends on the composition of the metal and its uniformity. With proper supervision, it is possible to control silicon and manganese variations within 0.10 per cent. Charged materials must we weighed accurately and the best iron is produced by rapid melting. Coke bed should extend from 45 to 50 inches above the tuyeres. Charges consist of pig iron, steel scrap up to 25 per cent, hard sprue and scrap, a small percentage of annealed scrap, limestone and fluorspar, and ferroalloys. Those are charged in the following order: Steel scrap, ferroalloys, pig iron, and hard and annealed scrap. A charge of flux equal to 5 per cent of the weight of the bed is placed upon the bed before charging. Limestone and fluorspar equal to 3 or 5 per cent of the charge, is placed on top of the coke between each charge. The author has had success with coke charges amounting to 11 per cent of the weight of the charge. Blast pressure in the wind belt is approximately 7 ounces. Metal is tapped at regular intervals at a temperature of approximately 2552 degrees Fahr.

Test bars are cast in accordance with the British Engineering Standards association specification No. 5022 for black-heart malleable castings and the average physical properties obtained are approximately 44,000 pounds per square inch ultimate tensile strength and 10 per cent elongation in 2 inches. Yield points is from 65 to 70 per cent of the ultimate strength. A torsion test also is made as a matter of routine to indicate the properties that may be expected from the castings.

Castings are annealed at 1742 to 1778 degrees Fahr. Soaking time varies from 40 to 60 hours. The oven is fired at a rate to reach the required temperature in 24 hours and the average soaking time is 48 hours. Round pots with an average life of 15 heats are used. The annealing ovens used are of a special design varying in capacity from 7 to 16 tons and are fired with a thin fuel oil introduced through a special type burner located in the roof of the furnace in which a reducing atmosphere is maintained.

Cleans Castings With Water

Economy of the Utilization of High-Pressure Water-Jet for Cleaning Castings (L'Economie de l'Utilisation du Jet d'Eau a Haute Pression pour le Nettoyage Moderne des Pieces de Fonderie), by E. Monnot. *La Revue de Fonderie Moderne*, Paris, Feb. 10, 1931.

Hydraulic cleaning of castings, according to the author, has several advantages from the standpoint of economy of time and labor, and also because it is claimed to be hygienic. Hydraulic cleaning is recommended for heavy castings, especially those containing a number of cores. That type cleaning can break up the cores, but does not destroy the chaplets. The article shows some heavy castings before and after cleaning by hydraulic methods, the water having a pressure of 1100 pounds per square inch. A table shows the time taken for the actual hydraulic cleaning. The time for chipping off risers and vitrified parts must be added, of course, to the time taken for hydraulic cleaning. The article also gives a description of the hydraulic equipment of Badishche Maschinenfabrik, Durlach, Germany, which is characterized by the use of a jet at high pressure, but with a nozzle of small diameter. That gives a comparatively fine jet which breaks up the sand in large pieces. The principles and operation of the equipment then are described.

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¶ Certifying the Product

THE certification plan in merchandising commodities constantly is gaining favor throughout the United States. As recently pointed out by the United States department of commerce, bureau of standards, organized consumer groups are definitely in favor of the application of the plan for facilitating the use of specifications, and the idea has been approved by governmental and institutional purchasers.

ACCORDING to the report, the purposes of such a plan are manifold. It is designed to make thoroughly effective the benefits derived by producers and consumers from economies incident to mass production, distribution and consumption. It encourages producers to manufacture staple commodities to comply with nationally recognized commodity specifications. Such a plan will assist producers in expanding their markets for staple commodities complying with nationally recognized specifications.

CERTIFICATION of product tends to facilitate and expand the use of national recognized commodity specifications by both large and medium quantity buyers. It will determine the commercial acceptability of certain nationally known specifications and aids in unifying specifications in use throughout the country. The certification plan also broadens the source of products conforming to the recognized specifications.

IN THE foundry industry, the idea of certifying the product was adopted several years ago by the Malleable Iron Research institute. In reviewing the progress of the Gray Iron institute and in pointing the way for future endeavor, President Seelbach, at the annual meeting in 1929, proposed the establishment of a method of certifying the product of member foundries. The work now being done by that organization in establishing classifications for gray cast iron will afford a basis upon which to build a certification plan for that group.

¶ Coming Out of It

LAST month a convention and show of an association serving one of the important, but limited industries was held in an eastern city. Some officials of the association gave the local hotel committee an estimate of 600 as the outside limit of individual room requirements. The registered attendance alone was in excess of 1600. Any analogy with the forthcoming American Foundrymen's association convention and exhibition in Chicago? From early indications, yes! Perhaps, all expectations will be exceeded in attendance May 4, 5, 6 and 7. The quality and direct value of the program and exhibition deserve such a response.

¶ Worship the Cupola

THE attitude of many, perhaps the majority, of men in gray iron foundries toward the cupola is strangely similar to the attitude displayed by the so called heathen toward the figures of wood and stone and metal which they fabricate, set up and then calmly endow with supernatural powers. A certain number regard them with awe and veneration and develop and practice a ritual and a ceremony full of strange movements and gestures. They jealously resent any comment from an outsider, particularly if that comment is in the form of an inquiry, why they do thus and so. These are the professionals, the favored few who are allowed to touch the body and therefore presumably are numbered with the elect who know all things and from whom nothing whatsoever is hidden. The remainder of the gang, heathen and foundry—and in some instances even a missionary could not tell them apart—regard the object as wonderful and mysterious.

COMES a day, in the argot of the West coast, when the regular cupola tender fails to report for duty. A deputy is elected and told to do his best. Unless he has had former experience, he is so overwhelmed with awe that inevitably he forgets something. Instances are on record of men who forgot to place any sand on the bottom, any mud on the walls, any wood under the coke, or any coke under the iron. If the iron leaks through the bottom door, they indulge in profanity and high stepping. They waste water and sand instead of shutting off the wind for a few minutes. If the tap hole freezes the only course open is to drop the bottom. These and many other "accidents" could be avoided if foundrymen familiarized themselves with cupola operation. At one time when all information—and misinformation—was transmitted by word of mouth, ignorance of cupola practice was excusable. Under modern conditions with the subject constantly discussed in the technical press and with several excellent text books available, the cupola should present no mystery to those desiring knowledge.

Personal

Vincent C. Faulkner, editor, *Foundry Trade Journal,* London, and a past president of the Institute of British Foundrymen, is the author of the exchange paper from that organization to the American Foundrymen's association to be presented at the Chicago convention May 4-7. The paper is entitled "The British Foundry Industry." Mr. Faulkner was born in Sheffield, England, in 1888 and was educated at Wesley college. He has been associated with Hobson Houghton & Co., Ltd., and Vickers Ltd., both of Sheffield, where he specialized in the manufacture of electric furnace steel. During the war, he spent most of his time on the Continent placing electric furnaces in operation. He is a past president of the London branch of the I. B. F., a member of the A. F. A., Association Technique de Fonderie de France, Iron and Steel institute, and the Institute of Metals. He also has served as president of the Foundry Trades Equipment & Supplies association.

Clyde B. Mitchella, formerly chief engineer, Republic Rubber Co., Youngstown, O., has been appointed general manager, Adamson Machine Co., Akron, O.

W. Kimball Leach, formerly general manager, General Alloys Co., Boston, has been elected first vice president. He has been with the company since January, 1923.

Dr. C. L. Dine, Minster, O., has been elected president of St. Mary's Foundry Co., St. Mary's Ohio. **Charles Dine** St. Mary's, was elected vice president and general manager, and **J. W. Eiting,** Minster, secretary-treasurer.

James W. Witmer, sales manager, J. I. Case Co., Racine, Wis., since 1916, has been made assistant to C. R. Messinger, president, Oliver Farm Equipment Co., South Bend, Ind. Mr. Witmer had been connected with the J. I. Case company since 1902, except for a short period.

A. J. Vierling, president, Paxton & Vierling Iron Works, Omaha, Nebr., since early last year, has been elected chairman of the board. Other officers are **D. T. Moltrop,** president, **F. E. Owen,** vice president and manager, and **Hird Styker,** secretary and vice president.

Give Alloy Properties

The American Society for Testing Materials recently published a booklet containing 11 tables giving the chemical compositions, physical and mechanical properties, and corrosion resistant properties of heat resisting and corrosion resisting alloys. The tables are folded to form a book 5¾ x 9¼ inches, and include data on chromium, chromium-nickel, and other special steels; nickel and high-nickel alloys; brasses, bronzes and other copper alloys, and aluminum alloys. Those materials represent standard products of 44 different firms and include both cast and wrought materials. The booklet may be obtained from the society, 1315 Spruce street, Philadelphia, for $1.50.

New England Founders Hold Meeting

The regular monthly meeting of the New England Foundrymen's association was held in the rooms of the Engineers club, Boston, Feb. 11, with 59 members in attendance. The meeting was called presided over by President Luther J. Anthony.

H. M. Lane, Detroit, gave an interesting talk on the subjects "Various Types of Melting" and "Modern Foundry Arrangements and Installations throughout the Country." A number of instructive lantern slides also were shown and a spirited discussion followed the speaker's remarks.

Bulletin Contains Data on Molybdenum

Climax Molybdenum Co., 295 Madison avenue, New York, has issued a 22-page booklet on the use of molybdenum in cast iron. The bulletin gives information regarding the effects of that alloy on the physical properties, growth and expansion. Various irons including those used for autmotive castings, machinery and dies are discussed. The effects of that alloy on irons to resist wear, high test and electric furnace irons and chilled iron are explained. Information also is given relating to the use of molybdenum with other alloys. The latter section of the bulletin deals with the melting of iron in the cupola and the methods used to add molybdenum alloys. Shrinkage, risers, fluidity, chilling effect and control also receive comment. The bulletin is illustrated with charts and curves showing the effect of the alloy on dilation, growth and expansion. Micrographs of various types of irons are shown. Tables show the chemical and physical properties of the irons.

Book Review

Engineering Materials, Vol. I, ferrous materials, by Arthur W. Judge, cloth, 5½ x 8½ inches, 683 pages, published by Isaac Pitman & Sons, New York, and supplied by THE FOUNDRY for $8.50 plus 15 cents postage, and in London by the Penton Publishing Co. Ltd., 116-17 Caxton House, Westminster, for 42s 6d, postage extra.

The volume is the outcome of a somewhat extensive revision of the author's *Aircraft and Automobile Materials,* Vol. I. ferrous, written in 1919. Some data on the theory and testing of materials incorporated in the former book is absent in the present work, being covered in Vol. III of the engineering materials series written by the same author.

The author in compiling this reference work has made a collection of the more important information on ferrous materials ordinarily used in engineering, and has presented the data and information in a logical and well-classified manner. The book is organized and the material presented in a manner that should make it of value to the engineer, designer, student, or other person concerned with the application of engineering materials. The metallurgical and metallographical sides of the subject are given only in outline, the emphasis of the book being placed on the physical and mechanical properties, heat treatments, processes, compositions, and applications of the ferrous materials discussed.

Cast iron, steels, special alloy steels, tool steels, and practically every commercial form of iron product is discussed. A chapter is devoted to the various cast iron products, gray and white irons, malleable irons, and semi-steel. Steel castings also are discussed at length. The effects of various alloy additions to castings is considered. The subject matter is presented for the user of the products rather for the maker. The book is an English work and, though the materials covered are international in scope in most processes, many of the standards and specifications presented throughout the volume represent English practice.

Firm Traces History

In celebration of its sixtieth anniversary, Ludwig Loewe & Co. Actiengesellschaft, Berlin, has published a handsome 212-page memorial volume containing a history of the firm, and its 60 years of development work. The historical portion of the volume was written by Dr. Conrad Matschoss and traces the rise and development of the firm which was founded by the first Ludwig Loewe in 1869 for the manufacture of sewing machines, and now is one of the largest machine tool builders in Germany. The second section devoted to the development work carried on by the firm during the past 60 years was written by Dr. G. Schlesinger. It also includes short descriptions of the modern gray iron, brass and die casting foundries of the firm. The VDI-Verlag, G.m.b.H., Berlin, which printed the volume is to be congratulated on its excellent display of printing craftsmanship.

James A. Fairfield has been made manager, grinding wheel sales, New York Belting & Packing Co., 91 Chambers street, New York. Mr. Fairfield formerly was sales manager, Marschke division, Black & Decker Mfg. Co., Towson, Md.

OBITUARY

Ernest G. Ackerman, superintendent and part owner, Dayton Castings Co., Dayton, O., died Feb. 27 as a result of injuries received in an automobile accident.

Thomas D. Thomas, 81 formerly an executive of the Hayden Foundry Co., Columbus, O., where he lived for the past 57 years, died Feb. 20. A native of Wales, he located in America at the age of 17 and lived for a time in New Jersey.

William B. Eisert, superintendent of the foundry, Pennsylvania Boiler Works, Erie Pa., died recently at his home in that city following a short illness. He had been superintendent of the company's foundry since it opened 38 years ago.

Frank E. Wheeler, president, International Heater Co., Utica, N. Y., died Feb. 17. He was born in Utica, April 9, 1853; and received his early education in the public schools. He attended Yale college and was graduated in 1876 after which he became a partner of his father, Russel Wheeler in the foundry firm of Russel Wheeler & Son, Utica. That firm later was merged with several others to form the International company. Mr. Wheeler was active in social, civic and church organization and was a member of the board of directors of several banks and industrial organizations.

George J. Mockley, 72 years old, pioneer foundryman of Wisconsin, but for 15 years a resident of Seattle, Wash., died in that city Feb. 24. He was president of the South Seattle Foundry Co., of which his son, George W. Mockley, is vice president and manager. He formerly owned the Neenah-Menasha Foundry Co., Neenah, Wis., and later became interested in the Liberty Foundry Co., Wauwatosa, then forming the Middle States Foundry & Mfg. Co., Milwaukee, of which he was president until his death. Another son, Edward G. Mockley, is secretary-treasurer and manager of the Middle States Foundry & Mfg. Co., Milwaukee.

Lothar R. Zifferer, president of Columbia Malleable Castings Co., Columbia, Pa., died of pneumonia in that city Feb. 19. Mr. Zifferer, the son of Austrian parents, was born in San Francisco in 1886. His father died when he was 5 years old and he was sent back to Austria to receive his early education in Vienna. Later he returned to the United States and was graduated from Santa Clara university, Santa Clara, Calif. He worked for the Automatic Sprinkler Co., of America and the American Tobacco Co., for a short time and then organized the Standard Expansion Bolt Co., to manufacture an expansion bolt which he had invented. Later he founded the United States Expansion Bolt Co. To secure a supply of malleable castings he first acquired an existing plant in Columbia, Pa. A year ago he built and placed in operation a magnificent foundry for the production of expansion bolt appendages and pipe fittings. He also was president of the Canadian Expansion Bolt Co. and the Hygeia Can Co., Utica, N. Y.

Ray Doty Is Dead

Ray J. Doty, plant manager, Reading Steel Casting Co., Reading, Pa., died Feb. 24 at the age of 47 years. Mr. Doty was well known throughout the foundry industry and was extremely active in association work, especially in the American Foundrymen's association and in the Steel Founder's Society of America. At the recent meeting of the nominating committee of the A. F. A. he was nominated as

Ray J. Doty

a director of that organization for a 3-year term.

Mr. Doty's interest in group activities centered on technical research and foundry education. At the time of his death, he was serving as chairman of the technical research committee, Steel Founders' Society of America and was that organization's representative on the joint committee on foundry education in engineering schools. He also was serving as a member of the American Foundrymen's association joint committee on molding sand research, the subcommittee on standard tests and committee on specifications for steel castings of the steel division. He also was a member of the 1930 nominating committee.

Born Jan. 17, 1884, in Hartford, Conn., he was graduated from the Sheffield Scientific school, Yale university, with a degree in mechanical engineering in 1907. Following graduation, he became a special apprentice with the Power Specialty Co., Dansville, N. Y., now a division of the Foster-Wheeler Corp., New York, and was appointed foundry foreman late in 1907. In 1912, Mr. Doty became associated with the Isaac G. Johnson Co., Spuyten Duyvil, N. Y., where he served as foreman in the open-hearth department, foundry foreman and finally superintendent. He joined the Sivyer Steel Casting Co., Milwaukee, in 1917 as superintendent in charge of operations and was made vice president, works manager and elected to the board of directors in 1922. Mr. Doty resigned those positions in 1927 and the following year became manager of the Reading Steel Casting Co., Reading, Pa., a position he held until his recent death.

Foundry Refractories To Be Simplified

The joint committee on foundry refractories sponsored by the American Foundrymen's association and the American Ceramic society recently requested the services of the division of simplified practice, bureau of standards, department of commerce, in establishing a simplified practice recommendation covering sizes and shapes of cupola blocks, tap-out blocks and slag-hole blocks. A questionnaire requesting information on refractory shapes for cast iron foundries has been prepared and now is being circulated among manufacturers of those products.

Steel Founders To Meet

Steel Founders' Society of America will hold a regional meeting March 19 and 20, at Columbus, O., which will be devoted to a discussion of sales problems. General sessions and meetings of special divisions will be held March 19. The second day will be devoted exclusively to a discussion of sales problems under the direction of E. St. Elmo Lewis, expert on merchandising and sales promotion. Over 300 casting salesmen and sales managers from all parts of the country are expected to attend.

W. H. Worrilow, Lebanon Steel Foundry, Lebanon, Pa., president of the society and W. W. Powell, Mesta Machine Co., West Homestead, Pa., vice president and chairman of the Central-Atlantic division of the society, will preside at the regular meetings. Group and committee meetings also will be held. John J. Baum, engineer and metallurgist, will address the small castings division on "New Uses for Cast Steel." Prof. W. Trinks, professor of mechanical engineering, Carnegie Institute of Technology, Pittsburgh, will present a paper on "The Selection of Materials in Machine Design."

Duriron Co., Dayton, O., recently opened a factory branch office at 7-252 General Motors building, Detroit. Richard R. Rourke has been appointed manager.

Miller Is Applicable To Many Patterns

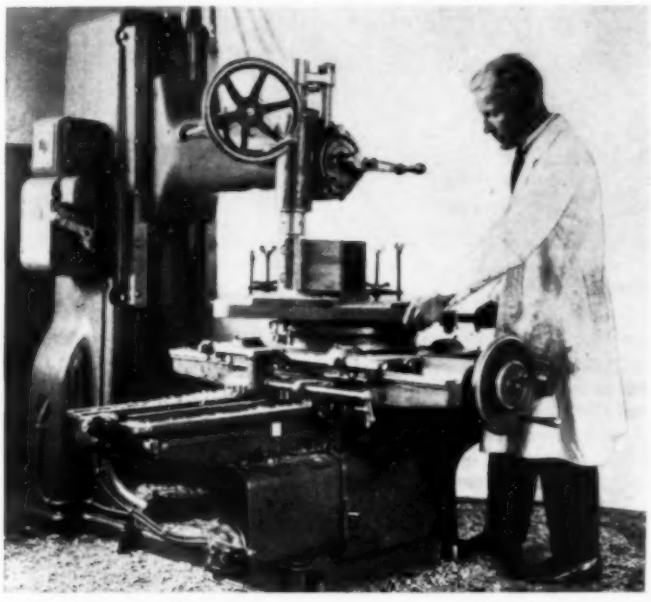
Wadkin & Co., Manchester, England, through its American sales agent, the Oliver Machinery Co., Grand Rapids, Mich., recently has introduced a new pattern miller that is applicable to many type patterns. The machine is made on the same principles as another type made by that company but is smaller. It is flexible enough to give convenient operation on geometric and irregular patterns and is equipped with quick action, fine-feed motions and stops for automatically controlling the limits of cutting.

The main frame is a heavy casting with machined slides which carry an overhanging arm. The arm supports the spindle head which is raised and lowered by hand motion by a worm gear and wheel and a larger wheel at a convenient position on the arm. The spindle head swivels between the vertical and horizontal. The principal angles are indexed and located by a tapered spring plunger which engages with suitable holes. Intermediate angles are registered by a scale divided in degrees. The head is secured by a locking handle.

The spindle runs in heavy ball bearings contained in dust proof housings. Spindle thrust is taken by ball bearings arranged to take the thrust load only. Spindle feed is controlled by a hand lever mounted in the center of the spindle head. Spindle feed mechanism is provided with a spring plunger to give definite depths and limit stops.

The cutter spindle is driven by another spindle running the length of the arm. A pulley, belt driven from the motor pulley or countershaft in the base of the main frame, is located on the main frame end of the driving spindle. The belt is arranged so that raising and lowering the arm does not affect the correct belt tension. Drive is transmitted to the cutter spindle by spiral gears totally enclosed and packed in grease.

Two spindle speeds, 4300 and 2700 revolutions per minute, are provided to suit various sizes and types of cutters. Those speeds are obtained either by a variable speed motor, if the machine is electrically driven, or by a two-speed gear box connected to the main drive shaft if it is belt driven. The table is provided at regular intervals with tapped holes for securing adjustable holding clamps. The table has three motions; two at right angles to each other controlled by screw and hand wheel, and a rotary movement controlled by a hand lever arranged with a spring plunger taper pin which engages in holes at the principal angles. The table has a longitudinal traverse of 44 inches and a horizontal traverse of 22 inches.

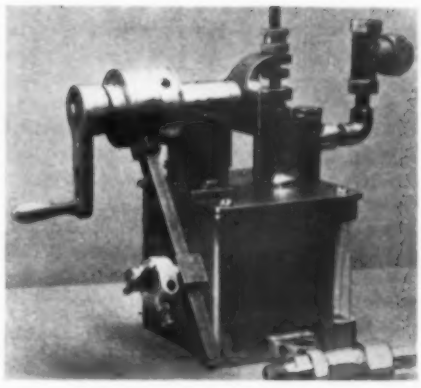


The Spindle May Be Operated in Either Horizontal, Vertical or Angular Positions. Principal Angles Are Indexed and Located by a Tapered Spring Plunger Which Engages in Suitable Holes. Intermediate Angles Are Registered by a Scale Divided in Degrees

Builds New Lubricator

Hills-McCanna Co., 2349 Nelson street, Chicago, has developed a lubricator available with either a clutch or ratchet type driving mechanism. The clutch mechanism consists of rollers held in place by springs and embodied in a housing. The rollers work with and against the crankshaft when it is operating.

The drive may be attached to high speed driving arms in any position within the arc of a circle. The drive also is claimed to give greater speed to the lubricator in delivering oil. Parts are hardened and packed in grease. The mechanism is interchangable with ratchet drives used on other models. A new style charging arm or crankshaft for flushing cylinders when starting or to increase flow when the lubricator is in operation in a feature. The lubricator is shown in the accompanying illustration.



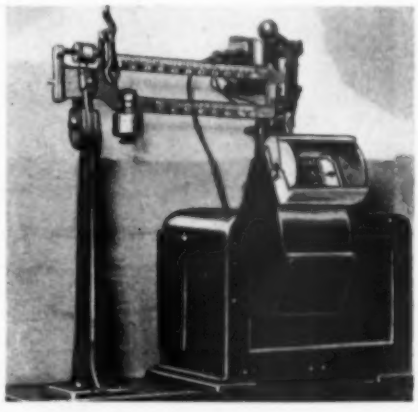
The Mechanism Is Equipped with a New Style Charging Arm

Projection Attachment Simplifies Weighing

Howe Scale Co., Rutland, Vt., recently has introduced a device which may be attached to any built-in-type beam scale from 1000 pounds capacity upward, for the accurate, direct reading of weights. It may also be applied to dial type scales by removing the dial head. The device is designed especially for industrial use. and has only one moving part.

The device consists of a metal case which fits under the outer end of the scale beam and rests upon the frame supporting the beam assembly. A rod connects the free end of the beam and passes through the top of the case to connect with a flexible strap. This in turn is attached to a drum which is a part of a counter-weighted lever carried on a ball bearing pivot. The outer end of the lever carries a slotted segment. A precision scale of transparent material with clear divisions and figures on an opaque back ground is located in the slot.

An electric light is located behind the scale and a projection lens in front. When in operation, the optical system throws an image of a magnified portion of the scale on a ground



Figures Are Read Easily on the Ground Glass

glass plate marked with an indicating pointer. The plate is about 2½ x 4½ inches and is mounted in the case in a position for convenient reading. When the scale is in operation, it comes to balance and the weight is flashed on the plate in figures ½-inch high. Readings may be made from a considerable distance in practically any degree of light or dark. It is claimed that there is an entire absence of parallax. The accompanying illustration shows one of the instruments.

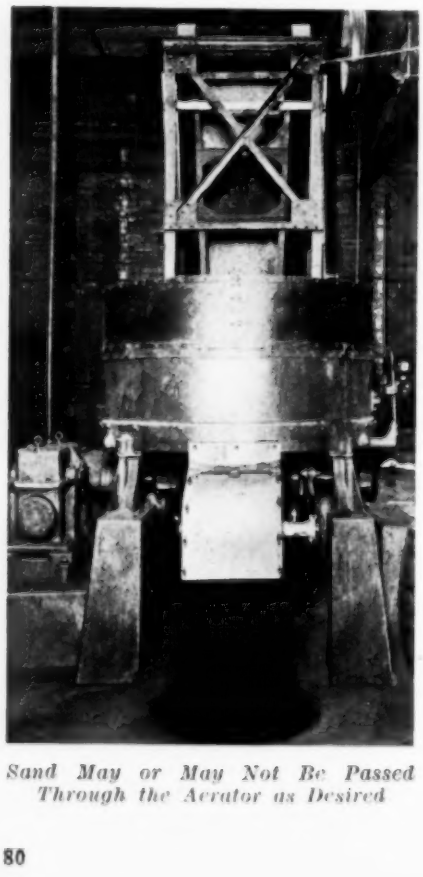
Cut-off Machine Used To Remove Risers

Cyril A. Fox, 337 Oliver building, Pittsburgh, has developed a machine for removing gates and risers from heat resisting alloy steel, brass, bronze and other castings. The machine uses 20-inch rubber bonded, high speed wheels, 3/16-inch thick with a 6-inch hole. The wheel operates at approximately 11,000 surface feet per minute and is driven by a multiple V-belt from a totally enclosed, fan cooled, ball bearing motor mounted on the rear of a rocking arm. The wheel is mounted on the front end of the same arm and is balanced so that the motor end is slightly heavier than the wheel end.

The wheel may be operated at two speeds. When the wheel is worn to the smaller diameter, belts are changed to give the higher speed which is the correct peripheral speed for that diameter wheel. A safety locking device prevents changing the speed of the wheel until reduced to the proper diameter. It also is impossible to mount a wheel until the speed ratio is correct.

The work holding table and clamping device is mounted at the front of the machine. It consists of a clamp formed like a hook on one and provided with slots on the other. The slots fit over an eccentric pin actuated by a lever so that the operator may hold the work clamped tightly with his left hand while bringing the wheel down to cut off the sprue or gate with the other.

Where castings are too large to place upon the work rest or are irregularly shaped, the rest may be removed and the work held against the front of the machine. The grinding wheel unit may be moved forward by a rack and pinion device to overhang the front of the machine to facilitate grinding in that position.



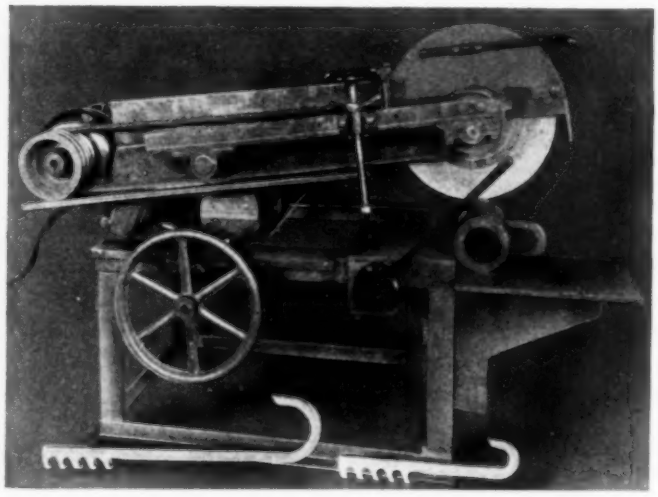
Sand May or May Not Be Passed Through the Aerator as Desired

Aerator Is Used with Sand Mixer

National Engineering Co., 549 West Washington boulevard, Chicago, has introduced a new type sand aerator designed to be installed on any No. 2, 6-foot diameter, sand mixer made by the company. The machine is constructed to take the peak load of the mixer and discharge the sand into a suitable receptacle or on the floor in a fluffy, moldable condition.

The areator consists of a steel drum mounted on a shaft carried on three ball bearings. The drum is equipped with a removable cage consisting of longitudinal steel blades. The edges of the blades are notched to give the cutting action an aerating effect upon the sand. A by-pass gate is provided so that if core and facing sands are being mixed in the same machine or if it is unnecessary to aerate a batch of sand, that gate may be thrown over and the sand will be discharged directly from the mill.

The accompanying illustration shows the machine attached to a mixer manufactured by the company. The National company expects soon to develop that type machine for its larger mixer.



High Speed Wheels, Operated at 11,000 Surface Feet Per Minute, Are Used on the Machine Which Is Driven by a Multiple V-Belt From a Totally Enclosed, Fan Cooled, Ball Bearing Motor Mounted at the Rear of a Rocking Arm

Malleable Chains Are Specially Treated

Jeffrey Mfg. Co., Columbus, O., recently has placed upon the market a new line of malleable iron chains and buckets for conveyors. The malleable iron used in that equipment is specially treated and is being sold under the trade name supermal. According to the Jeffrey company, the material combines extreme hardness with toughness. The iron is said to have the following physical properties: Yield point, 51,000 pounds per square inch; ultimate strength, 65,000 pounds per square inch; elongation in 2 inches, 8 per cent; brinell hardness number, 180-200; and scleroscope hardness, 40-45.

Another feature of the specially treated iron is that its surface cannot be touched with the flat of a file, yet it retains toughness and ductility. That property gives it high resistance to abrasion. The material is said not to be brittle even in thin sections. The Jeffrey Mfg. Co. recommends the use of the specially treated malleable iron for conveyors, elevators and chain drives subject to abrasive conditions. Chains, attachments and buckets are available in standard sizes.

Briquets Ferroalloys

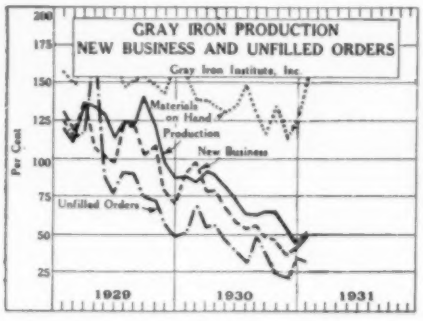
The Electro Metallurgical Sales Co., 30 East Forty-second street, New York, recently has placed ferrosilicon briquets on the market. The briquets which are cylindrical are made in two sizes weighing 2½ and 5 pounds each, and are for use in the cupola. A flux mixed with the ferrosilicon is said to reduce oxidation losses of the material to a considerable extent. Later the Electro Metallurgical Sales Co. will supply briquets of ferromanganese, ferrochromium, and other alloys for cupola use.

Trade Trends in Tabloid

A SLIGHT upward trend in foundry operations was noted in February, the improvement being attributed chiefly to a greater volume of business among specialty shops and increased orders from the makers of automobiles.

—T—T—

Improvement, which might even be classified as substantial, is reported in the malleable iron industry. February witnessed a continued increase in orders from the automobile industry and the requirements from railroads held at an even keel. While demand from the agricultural industry is rather quiet, more life is



noted in the output of trucks and tractors.

—T—T—

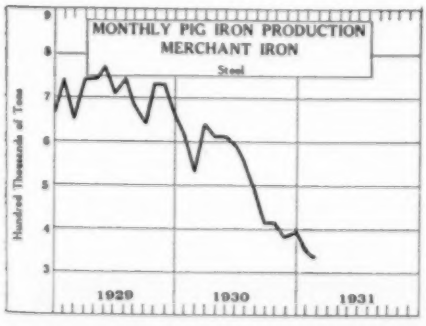
Preliminary reports indicate that automobile production in February exceeded 200,000 cars, compared with 171,903 units in January and 155,601 in December. Broadened releases for material indicate a continued improvement in output.

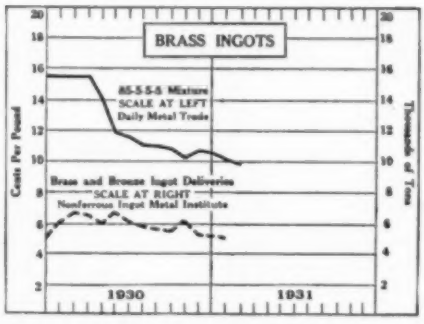
—T—T—

Chicago district foundry operations the first of March averaged around 40 per cent, showing little change since last September. Aluminum foundries, working about 4 days a week, are above the operating rate of the district. Brass foundry production is improving slightly.

—T—T—

Foundry operations in the Pittsburgh district changed little during February compared with January, but remained only slightly below the level of a year ago. Producers of heating equipment, such as radiators and boilers, are less active than early





in the year, but sanitary ware manufacturers are busier. Steel foundry operations are slightly better than in January.

—T—T—

Gradual improvement in rate of operations was reported in February by many nonferrous foundries in the Cleveland district. Much of this business continues to be derived from a large number of small orders.

—T—T—

Orders for malleable castings in January reached the highest total since last June, calling for 32,633 tons. Production for the month totaled 31,357 tons compared with 30,431 tons in December and 61,381 tons in January, 1930.

—T—T—

Slight increases in foundry operations are reported in the St. Louis district. Pig iron sales are increasing and some manufacturers, including the makers of stoves, heating apparatus, farm implements and

RAW MATERIAL PRICES
March 5, 1931

Iron	
No. 2 foundry, Valley	$17.00
No. 2 Southern, Birmingham	13.00
No. 2 foundry, Chicago	17.50
No. 2 foundry, Buffalo	17.50
Basic, Valley	17.00
Basic, Buffalo	17.00
Malleable, Chicago	17.50
Malleable, Buffalo	18.00
Coke	
Connellsville beehive coke	$3.25 to 4.85
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	8.50
Scrap	
Heavy melting steel, Valley	$12.00 to 12.50
Heavy melting steel, Pitts.	12.50 to 13.00
Heavy melting steel, Chicago	9.75 to 10.25
Stove plate, Buffalo	9.50 to 10.00
Stove plate, Chicago	7.75 to 8.25
No. 1 cast, New York	8.00 to 8.50
No. 1 cast, Chicago	9.50 to 10.00
No. 1 cast, Philadelphia	13.00
No. 1 cast, Pittsburgh	12.50 to 13.00
No. 1 cast, Birmingham	11.50 to 12.00
Car wheels, iron, Pittsburgh	13.50 to 14.00
Car wheels, iron, Chicago	10.75 to 11.25
Railroad malleable, Chicago	12.00 to 12.50
Agricultural mal., Chicago	10.50 to 11.00
Malleable, Buffalo	12.00 to 12.50
Nonferrous Metals	**Cents per pound**
Casting copper, refinery	10.25
Straits tin	26.75
Aluminum, No. 12, producers	22.00
Aluminum, No. 12, remelt	11.00 to 12.00
Lead, New York	4.60
Antimony, New York	7.00
Nickel, electro	35.00
Zinc, East St. Louis, Ill.	4.05

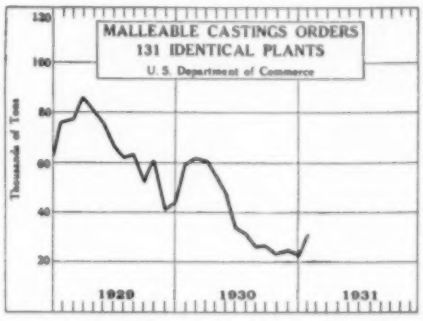
some classes of machinery are reported building up moderate accumulations of stocks.

—T—T—

Production of steel castings in January totaled 46,156 tons compared with 46,290 tons in December and 109,009 tons in January, 1930. New orders declined from 49,387 tons in December to 46,631 tons in January.

—T—T—

Daily production rate of pig iron in February increased 19.5 per cent, according to a compilation by STEEL. Despite the shorter month, the February total of 1,711,137 tons of pig



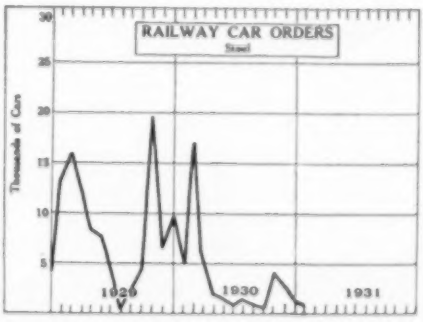
iron produced almost equalled the 1,715,443 tons made in January. Merchant iron produced totaled 336,085 tons in February compared with 355,431 tons in January.

—T—T—

Gray Iron production in January, according to the Gray Iron institute, Cleveland, reached 52.1 per cent of normal compared with 48.5 per cent in December. New business also increased from 47.2 per cent in December to 51.4 per cent in January. Most substantial gains were made in the east and central districts. A loss of 3 per cent was reported in the western section and in Chicago, production declined 10 per cent.

—T—T—

Average New York prices of nonferrous metals during February, according to *Daily Metal Trade*, were as follows: Casting copper, 9.698c; electrolytic copper, 9.951c; Straits tin, 26.301c,; lead, 4.552c; antimony, 7.052c; aluminum, 98-99, 22.90c. Zinc averaged 4.016c, East St. Louis, Ill.



What the Foundries Are Doing

Reflecting the Activities of Gray Iron, Malleable, Steel and Brass Shops

New Haven Foundry, New Haven, Mich., has increased operations.

Columbia Castings Co., 11 South Ferdinand avenue, Detroit, has discontinued the operation of its plant.

Terminal Brass & Iron Foundry, Brooklyn, N. Y., has been incorporated with $10,000 capital.

Glancy Malleable Corp., Waukesha, Wis., has added 30 men to its payroll and has started an additional furnace.

Ace Foundry Ltd., 8240 South Alameda street, Los Angeles, is erecting an additional building to be used for cleaning, shipping, and storage.

Since January 1, the Superior Casting Corp., South Norwalk, Conn., reports good business with operations at capacity.

Lidgerwood Pacific Co., Tacoma, Wash., has changed its name to the Pacific Iron & Steel Works and has reduced its capital to $200,000.

Timmins Foundry Co., Lexington, Ky., recently moved into its new plant on Shelby street and the Belt Line railroad. John Whalen is proprietor and manager. The foundry is operated as a jobbing shop for gray iron castings.

Norwalk Lock Co., Marshall street, South Norwalk, Conn., has been acquired by the Segal Lock & Hardware Co., Brooklyn, N. Y.

Bullard Co., Brewster and Canfield streets, Bridgeport, Conn., reports an improvement in business since the first of the year.

Operations at the Mackintosh-Hemphill Co., Midland, Pa., have increased 75 per cent. About 200 men now are employed.

Perfect Circle Co., Hagerstown, Ind., has increased its production 100 per cent according to a statement by C. N. Teetor, president.

John C. Truesdale has started the operation of a foundry in a plant on Muskegon street, Cedar Springs, Mich. The company will be known as the Cedar Springs Aluminum Foundry.

It is reported that the United Casting Co., Los Angeles, has leased the foundry building formerly owned by the Keystone Iron & Steel Co., Santa Fe avenue, Los Angeles.

United Engineering & Foundry Co., Grace avenue northeast and Fourteenth street, Canton, O., recently let contracts for additional buildings to the Geyvert Construction Co., Youngstown, O. (Noted Dec. 1.)

Erb-Joyce Foundry Co., Vassar, Mich., may move operations to Howell, Mich., to secure adequate electric power for the operation of a battery of electric furnaces which the company is considering installing.

Majestic Co., Huntington, Ind., has increased its capitalization to $300,000. New machinery to the extent of $30,000 has been installed and new products developed, according to Donald A. Purviance, secretary.

Republic Radiator & Mfg. Co., Baltimore, has been incorporated by Theodore C. Waters, First National Bank building, and has acquired the Republic Radiator Co., with a plant on Union avenue, Baltimore.

R. J. Coan and John L. Fisher have opened the Alameda Brass Foundry, 7223½ Cottage street, Huntington Park, Calif. Mr. Coan for several years was part owner of the Wilmington Brass Foundry, Wilmington, Calif.

Alhambra Foundry, 1147 Meridian street, Alhambra, Calif., has been incorporated as the Alhambra Foundry Co. Ltd., with a capital of $50,000 by F. A. Hopping, C. E. Hopping and Dorothy Meyn.

Contrary to a news item in the Feb. 15 issue, the Newbury Mfg. Co., Monroe, N. Y., will not move its plant from Monroe to Talladega, Ala. The company recently purchased the J. & B. Foundry Co. plant in the latter city but will continue to operate its Monroe plant as before. (Noted Feb. 15.)

Model Brass Foundry, 508 South Franklin street, Decatur, Ill., has sufficient orders to keep the plant operating at 100 per cent capacity for the first half of the year, according to C. V. McKelvey, vice president and general manager. The plant has been forced to work overtime to catch up on deliveries in the past few weeks.

New Trade Publications

FIRE BRICK—Features of a new fire brick developed by the A. P. Green Fire Brick Co., Mexico, Mo., are described in a booklet recently issued. Performance curves of the brick under test are given and photographic evidence of its durability is presented.

FLEXIBLE SHAFT MACHINE—A. N. Strand & Co., 5001-5009 North Lincoln street, Chicago, recently has published a new 56-page catalog illustrating and describing many new types and sizes of flexible shaft machines.

ELECTRICAL EQUIPMENT—General Electric Co., Schenectady, N. Y., has issued a number of bulletins as follows: Photoelectric relay, phase protective panels, fractional horsepower motors, squirrel-cage induction motors, and oil circuit breakers.

SPEED REDUCERS—W. A. Jones Foundry & Machine Co., 4401 Roosevelt road, Chicago, covers a new line of worm gear speed reducers in a special bulletin recently issued. The reducers are for electric motor drives up to 7 horsepower, ratios 5-1 to 50-1.

ROOFING CEMENT—Methods of application, properties, and uses of plastic and liquid roofing cement produced by the Federal Foundry Supply Co., 2639 East Seventy-ninth street, Cleveland, are covered in a folder recently issued. The cement is adaptable to a variety of uses in roofing work.

OIL BURNERS—A recent bulletin from Ryan, Scully & Co., Philadelphia, describes and illustrates design features of a low-pressure, automatic, oil burner particularly adapted to installations of one or two portable furnaces, core ovens, or other small heating units. The economy of the equipment is emphasized and service, control, and adaptations of the unit are considered.

PLATING ALUMINUM — Special methods necessary in electroplating aluminum sheet and castings and various aluminum alloys are described in a booklet recently issued by the Aluminum Company of America, Pittsburgh. Cleaning procedure and plating methods with various commercial electroplating metals are given along with photomicrographs of results and illustrations of parts successfully plated.

INGOT BRONZE—A recent bulletin from Tottenville Copper Co., Inc., executive offices, 609 West Twenty-ninth street, New York, is entitled "Facts About Ingot Bronze." The development and a description of the properties of a special alloyed ingot bronze for valves, meters or high-grade machinery castings is covered. Several other ingot metals also are described. An outline of the technical and consulting services offered by the company is given.

INDUSTRIAL HEATING — Industrial heating equipment made by the Westinghouse Electric Mfg. Co., East Pittsburgh, Pa., is covered in a 100-page catalog, recently issued. Operating data, charts, tables and installation photographs of the equipment are given. A control section is included describing magnetic controllers, push button stations, furnace transformers, thermometers, thermostats, pyrometers, etc.

ARC WELDING—Hobart Bros. Co., Troy, O., recently issued an 80-page, pocket-size book presenting essential facts for successful application of electric arc welding processes. Nine chapters are devoted to such topics: The welding arc; welding equipment; types of joints; weldability of metals, etc. The information given is presented in brief, logical, and nontechnical manner including useful information derived from practical experience. Welding products and equipment made by the company are described and illustrated.